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Synopsis of *Diplazium* (Athyriaceae) from Brazil

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ABSTRACT.—A taxonomic revision of Brazilian *Diplazium* recognized 28 species. The majority of these species are associated with preserved moist forest environments. The monographic study of *Diplazium*, as suggested by several authors over the last 30 years, has been difficult due to the large number of widely distributed taxa. Nine species are endemic to Brazil: *Diplazium adnatum*, *D. brachycarpum*, *D. fimbriatum*, *D. leptochlamys*, *D. leptocarpon*, *D. longipes*, *D. mickelii*, *D. mutilum*, *D. tamandarei*. We present an identification key for species with their descriptions, and illustrations. Twenty one lectotypes are also listed.

KEY WORDS.—Athyriaceae, Athyrioids ferns, Atlantic Forest, South America, taxonomy.

Diplazium comprises ca. 400 species, widely distributed in the tropical and subtropical regions, and is generally associated with preserved humid forests. In the Neotropics, there are about 150 species of *Diplazium* (Mickel and Smith, 2004), with greatest diversity in the Andean and Guyanan regions. *Diplazium* is predominantly terrestrial, and is characterized by stems generally erect bearing non-clathrate scales at the apex, with monomorphic leaves (rarely dimorphic), leaves simple to 1-4 pinnate-pinnatifid, glabrous or pubescent, and with free or anastomosing veins, without included veinlets, sori “back-to-back” along the same vein (diplazioid sorus), and by the indusium covering each sorus.

Swartz (1802) described *Diplazium*, but the classification of this genus was doubtful for many years. *Diplazium* species have been classified into various families, e.g., Polypodiaceae *s.l.* (Baker, 1870; Hooker, 1860; Mettenius, 1856; Smith, 1841; Willdenow, 1810), Aspleniaceae (Presl, 1836, 1849), Athyriaceae (Ching, 1954; Ching, 1978 a, b; Pichi-Sermolli, 1977), Dryopteridaceae (Physematieae) (Kramer, *et al.* 1990; Tryon and Tryon, 1982) and Woodsiaceae (Smith *et al.*, 2006). Phylogenetic studies have improved knowledge of the relationships among the leptosporangiatae ferns, allowing for the recognition of new families and genera, especially in the suborder Aspleniineae (Sano *et al.*, 2000; Wang *et al.*, 2003; Wei, Zhang, and Qi, 2010; Kuo *et al.*, 2011; Li *et al.*, 2011; Rothfels *et al.*, 2012; Mynssen *et al.*, 2016). Currently, *Diplazium* is included in Athyriaceae, which comprises three genera and ca. 650 species (PPG I, 2016). An infrageneric classification for *Diplazium* was proposed (Wei, Schneider, and Zhang, 2013) based on molecular analysis and as a result of a reconstruction of the evolutionary patterns and morphological characters,

mainly including Asiatic species. These authors recognize four subgenera, *Pseudallantodia*, *Diplazium*, *Sibirica*, and *Callipteris*.

Knowledge of the Neotropical species has been increased based on study of regional floras or catalogs: Mexico (Mickel and Beitel, 1988; Mickel and Smith, 2004), Central America (Adams, 1995; Stolze, 1981), Puerto Rico and Jamaica (Proctor 1977, 1985, 1989), Suriname (Kramer, 1978), Venezuelan Guayana and Guiana Shield (Funk *et al.*, 2007; Smith, 1995), Colombia (Murillo, Murillo, and León, 2015), Ecuador (Moran, 2004; Stolze, Pacheco, and Øllgaard, 1994), Peru (Tryon and Stolze, 1991), Bolivia (Jørgensen *et al.*, 2005; Kessler and Smith, 2017; Sundue, 2010), and Argentina (Arana and Mynssen, 2016; Arana, Mynssen, and Ponce, 2017). In Brazil, *Diplazium* was treated in floristic studies (Angely, 1963; Barros *et al.*, 2002; Cislinski, 1996; Fée 1869, 1872-73; Melo and Salino, 2002; Mynssen, Sylvestre, and Andreatta, 2002; Mynssen and Windisch, 2004; Prado, 1998; Rizzini, 1953-54; Salino, 1996; Salino and Joly, 2001; Sehnem, 1979). However, a comprehensive monographic study of this genus is lacking. It is therefore necessary to propose a new classification, including neo- and paleotropic species.

This work presents a revision of *Diplazium* from Brazil, increasing the knowledge about the Neotropical species of the genus.

MATERIAL AND METHODS

Specimens were collected in the humid forests of southeastern and southern Brazil. Additionally we examined the following herbarium collections: AAU, B, BAUR, BM, BHCN, C, CEPEC, CESJ, COR, CR, CRLS, EAC, ESA, GUA, HB, HBR, HRB, HRCB, HUEFS, ICN, INPA, IPA, JPB, K, MBM, MBML, MG, MVM, NX, NY, OUP, P, PACA, PH, R, RB, RBR, RUSU, S, SP, SPF, SJRP, UEC, UPCB, US, VIC (Thiers 2017). The barcode number is given for each type specimen cited, after the herbarium code. We assumed inadvertent lectotypifications previously indicated as holotype (Prado *et al.*, 2015; McNeill, 2014). In some cases, new lectotypes were selected. All descriptions follow the technical terms proposed by Ogura (1972), Tryon and Lugardon (1991), Lellinger (2002), and Stearn (2004). In the "Selected specimens examined" sections, only one specimen is cited per state of Brazil. The distribution maps incorporate all localities from specimens examined. These specimens are listed in the "List of collectors names and numbers" (Appendix 1).

Spores were scattered coated on a stub with gold-palladium in a sputter-coater for 2.5 minutes, and their images were obtained with a SEM with an EVO 40 at 15 kV.

For anatomical analysis, the petioles and laminae were collected and fixed in glutaraldehyde 2.5% or FAA 50%. They were then dehydrated in an ethanol series and embedded in hydroxyethylmethacrylate (Gerrits and Smid, 1983) and sliced transversely into sections 2–3 μm in thickness using a D-profile microtome knife in a Shandon Hypercut microtome, affixed to glass slides, and stained with Toluidine Blue O 0.05% (O'Brien and McCully, 1981). We obtained images using a Coolsnap digital camera attached to an Olympus BX50

microscope with the aid of the image analysis software Image Pro-Plus (v.4.0, version for Windows).

MORPHOLOGY

The majority of *Diplazium* species are large plants, more than 2 m in length, although some only reach around 30 cm. In populations of species with 2–3 pinnate-pinnatifid lamina, neotenic individuals are frequently found. Their stems are erect, decumbent or reptant, and the leaves are monomorphic or rarely subdimorphic, entire or pinnatifid, with apical pinnae conform or pinnatifid, and median pinnae equilateral or inequilateral. The petioles and the rachis are terete or grooved, and this groove opens adaxially toward the proximal side of the pinnae, often forming narrow wings and lacinia. Frequently, both the petiole and rachis have linear aerophores laterally located and lighter in color (Figs. 1A–H).

The morphological study of the foliar axes has been important to show different stellar patterns. This character has been useful for delimiting groups in *Diplazium* as pointed out by some authors in the athyrioid ferns (e.g., Kato, 1977; Hernandez *et al.* 2007, 2009; Praptosuwiryo, 2008; Umilkalson, 1992). The transection of the petiole and rachis shows two steles facing each other, shaped like a hippocampus (Figs. 1E and 1L). These two vascular bundles unite distally on the rachis, from the metaxylem extending to the rachis, and become U-shaped or V-shaped with the open end oriented adaxially (Figs. 1M–N). In some cases, the stele continues to be separated until the rachis (e.g., *Diplazium roemerianum*). Slim isodiametric cells with mucilage form the cortex. The mucilaginous cavities are found in the parenchyma associated with the xylem of the petioles, rachis, and costae (Pacheco *et al.*, 2003). In dense and humid forests some species may occur in populations and it is common to find insect larvae in those whose petiole diameter is greater than 1.5 cm and rich in mucilage (e.g., *Diplazium rostratum* and *D. leptocarpon*). The epidermis is unistratose and the epidermal cells have slightly sinuous walls from the top view, and anomocytic stomata are distributed across the surface. The veins are free, simple, or forked in the majority of species, though some such as *Diplazium aberrans* and *D. praestans* have anastomosing veins without veinlets included. Different types of trichomes characterize the indument of the axis and lamina: simple and acicular (e.g., *Diplazium striatastrum*), glandular (e.g., *D. gracilescens*), and septate catenate (e.g., *D. asplenoides*). Scales are linear to lanceolate, non-clathrate, concolorous or bicolored with the margin entire, glandular or dentate, and with teeth simple or bifid (Fig. 1).

Most species of *Diplazium* have sori bordering both sides of the veins (diplazioid sori), and the indusia are linear, elliptic, oblong, or vestigial in *D. lindbergii* (Fig. 1Q). The indusium margin is entire, lobate, laciniate, or fimbriate and is an important character for recognizing some species. However, in many dried specimens, the indusium margin is folded up and is not evident. The spores are ellipsoidal, monoletate with folds above and inner papillate

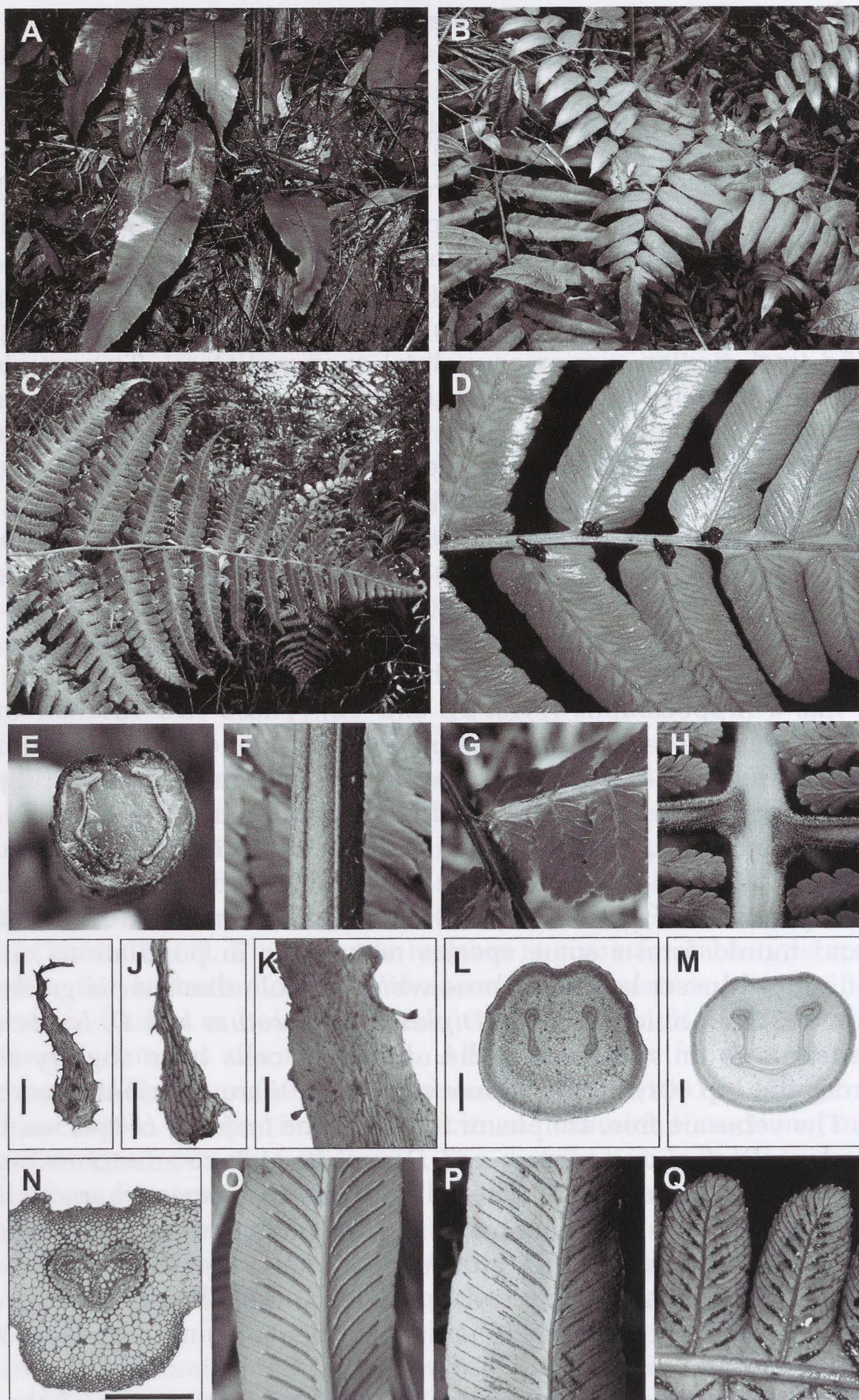


FIG. 1. A. *Diplazium plantaginifolium*, habit (Mynssen et al. 950); B. *D. celtidifolium*, habit (Mynssen et al. 1168); C. *D. brachycarpum*, lamina detail (Mynssen et al. 996); D. *D. fimbriatum*, lamina detail showing the buds on the rachis (F.B.Matos 1395); E–F. *D. rostratum*, E. petiole transverse section showing two vascular bundles, F. petiole showing the aerophore (Mynssen et al. 994); G. *D. leptocarpon* lamina detail showing rachis and pinna-rachis wings (Mynssen et al. 1101); H. *D. leptocarpon* petiole detail (Mynssen et al. 1101); I–K. *D. rostratum* petiole details (Mynssen et al. 994); L–M. *D. rostratum* petiole transverse sections (Mynssen et al. 994); N. *D. rostratum* petiole transverse section with scale bar (Mynssen et al. 994); O. *D. rostratum* pinna detail (Mynssen et al. 994); P. *D. rostratum* pinna detail (Mynssen et al. 994); Q. *D. rostratum* pinna detail (Mynssen et al. 994).

perispore (Tryon and Lugardon, 1990). These folds are low and broad, characterized as cristate or usually long and narrow forming wings (Fig. 2). The folds are called reticulate when connected, with surface rugulate (*Diplazium celtidifolium*, Fig. 2F), smooth (*D. longipes*, Fig. 2K), echinulate (*D. plantaginifolium*, Fig. 2Q), coarsely echinulate (*D. leptocarpon*, Fig. 2I), granulated or perforate (*D. asplenoides*, Fig. 2D).

DISTRIBUTION PATTERN

In Brazilian biomes, the high richness of species occurs in wet and preserved forests even in terms of widely distributed species. Three species occur exclusively in the Amazon region: *Diplazium aberrans*, *D. gracilescens* and *D. praestans* (Fig. 3A). Nine species are endemic to Brazil; four of them (*Diplazium adnatum*, *D. leptochlamys*, *D. mickelii*, *D. tamandarei*) have a very restricted distribution found with only few populations in one or two localities (Fig. 3B). The other five endemic species (*Diplazium brachycarpum*, *D. fimbriatum*, *D. leptocarpon*, *D. longipes*, *D. mutilum*, Figs. 3C–F) occur along the Atlantic coast from “Hiléia Bahiana” (south of Bahia and north of Espírito Santo) to the Southeast/South. This pattern of distribution is also seen in non-endemic species: *Diplazium celtidifolium*, *D. herbaceum*, *D. riedelianum*, *D. roemerianum*, *D. rostratum* and *D. turgidum* (Figs. 3G–K). The Atlantic Forest presents the highest diversity and *Diplazium mattogrossense* and *D. petiolulatum* are the only species that are not distributed in the coastal forests (Fig. 3L). We consider five species with wide distribution in Brazilian biomes: *Diplazium ambiguum*, *D. asplenoides*, *D. cristatum*, *D. lindbergii*, *D. plantaginifolium* (Figs. 4A–E). We consider three species with new occurrences in Brazil, *Diplazium moccennianum*, *D. striatastrum*, *D. tabalosense* (Fig. 4F).

TAXONOMIC TREATMENT

Diplazium Sw., J. Bot. (Schrader) 1800 (2): 61. 1802. TYPE: *Asplenium plantagineum* L. nom superfl. to *Asplenium plantaginifolium* (L.) Urb.

Stems usually ascending to erect (sometimes trunk-like), scaly; scales non-clathrate, brown to blackish brown, their margins entire or toothed; petioles with two crescent-shaped vascular bundles in cross-section, these uniting

←
H. *D. tamandarei*, detail of the rachises with hairs (J.Pereira 438); I. *D. rostratum*, scale with margin bitoothed; J. *D. celtidifolium*, scale with margin simple toothed (Mynssen et F.B.Matos 1168); K. *D. herbaceum*, scale with glandular margin (Mynssen et al. 304); L. *D. roemerianum*, petiole distally showing vascular bundle face to face (Mynssen et F.B.Matos 1168); M. *D. brachycarpum*, petiole distally showing vascular bundle “U” form (Mynssen 996); N. *D. cristatum*, laminar section showing vascular bundle “V” form (Mynssen et al. 1070); O. *D. roemerianum*, pinnae showing simple sorus (Mynssen et al. 1168); P. *D. plantaginifolium*, lamina with diplazioid sorus (Mynssen et al. 950); Q. *D. lindbergii*, sorus with vestigial indusium (Mynssen et al. 1139). Scales bar = 0.5mm (Figs. I, J, K); 1 mm (Figs. L, M, N).

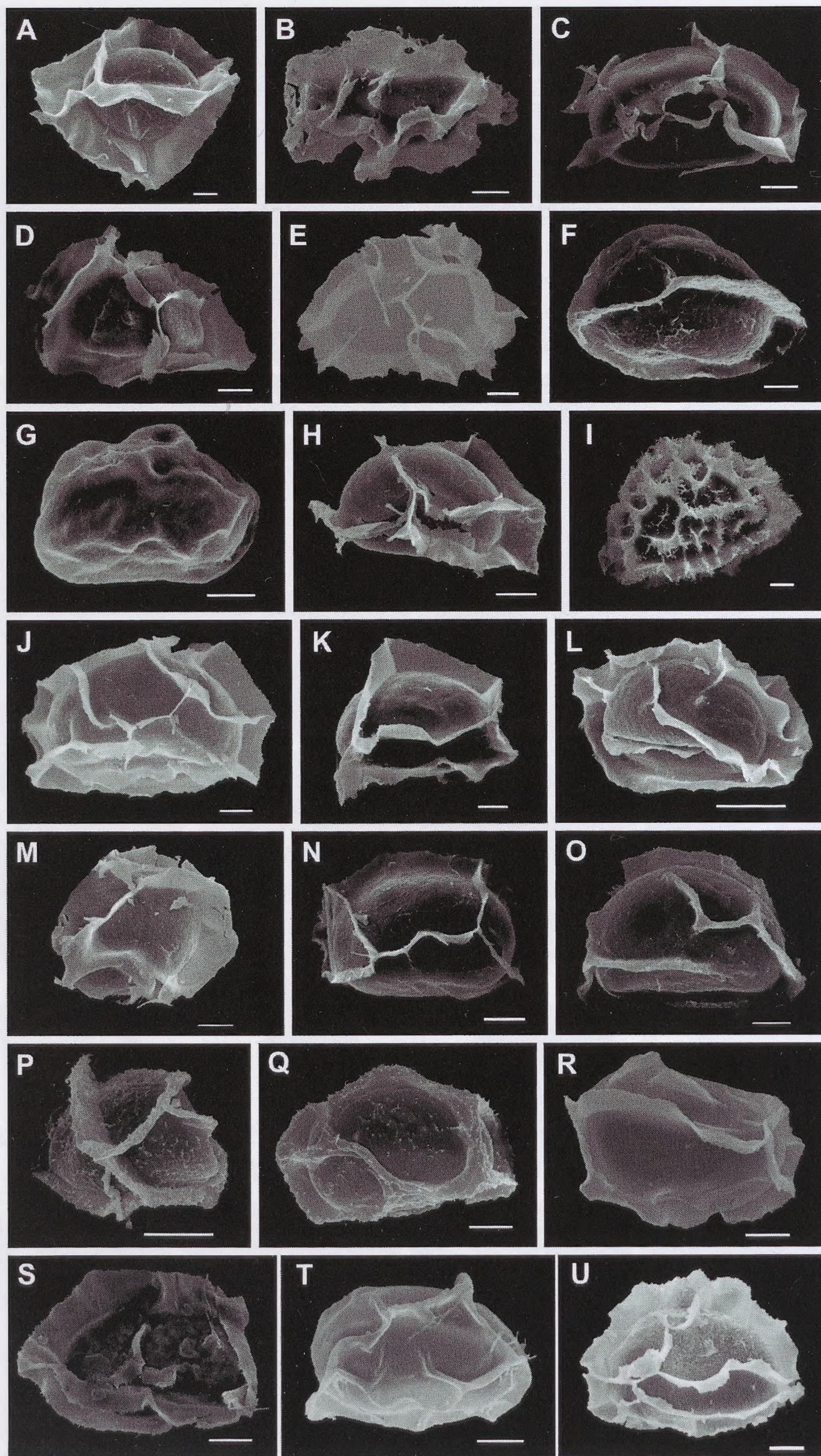


FIG. 2. Perispore morphology. A. *Diplazium aberrans* (Silva 60853); B. *D. adnatum* (Glaziou 7250); C. *D. ambiguum* (J.Prado 541); D. *D. asplenioides* (Brade 7661); E. *D. brachycarpum* (Mynssen et al., 996); F. *D. celtidifolium* (Braga 248); G. *D. herbaceum* (Duarte 5261); H. *D. leptochlamys* (Damasceno 617); I. *D. leptocarpon* (Salino 4222); J. *D. lindbergii* (Salino 2952); K. *D. longipes* (Kameyama 122); L. *D. mattogrossense* (Freitas 148); M. *D. mickelii* (Brade 19821); N. *D. moccennianum* (Sodiho); O. *D. mutilum* (Mynssen et al. 739); P. *D. petiolulatum* (Neiva 425); Q. *D. plantaginifolium* (F.B.Matos 1385); R. *D. roemerianum* (Mynssen et al. 955); S. *D. tabalosense* (Brade 17976); T. *D. tamandarei* (Brade 6529); U. *D. turgidum* (Mynssen et al. 956). Scale bar = 10 μ m.

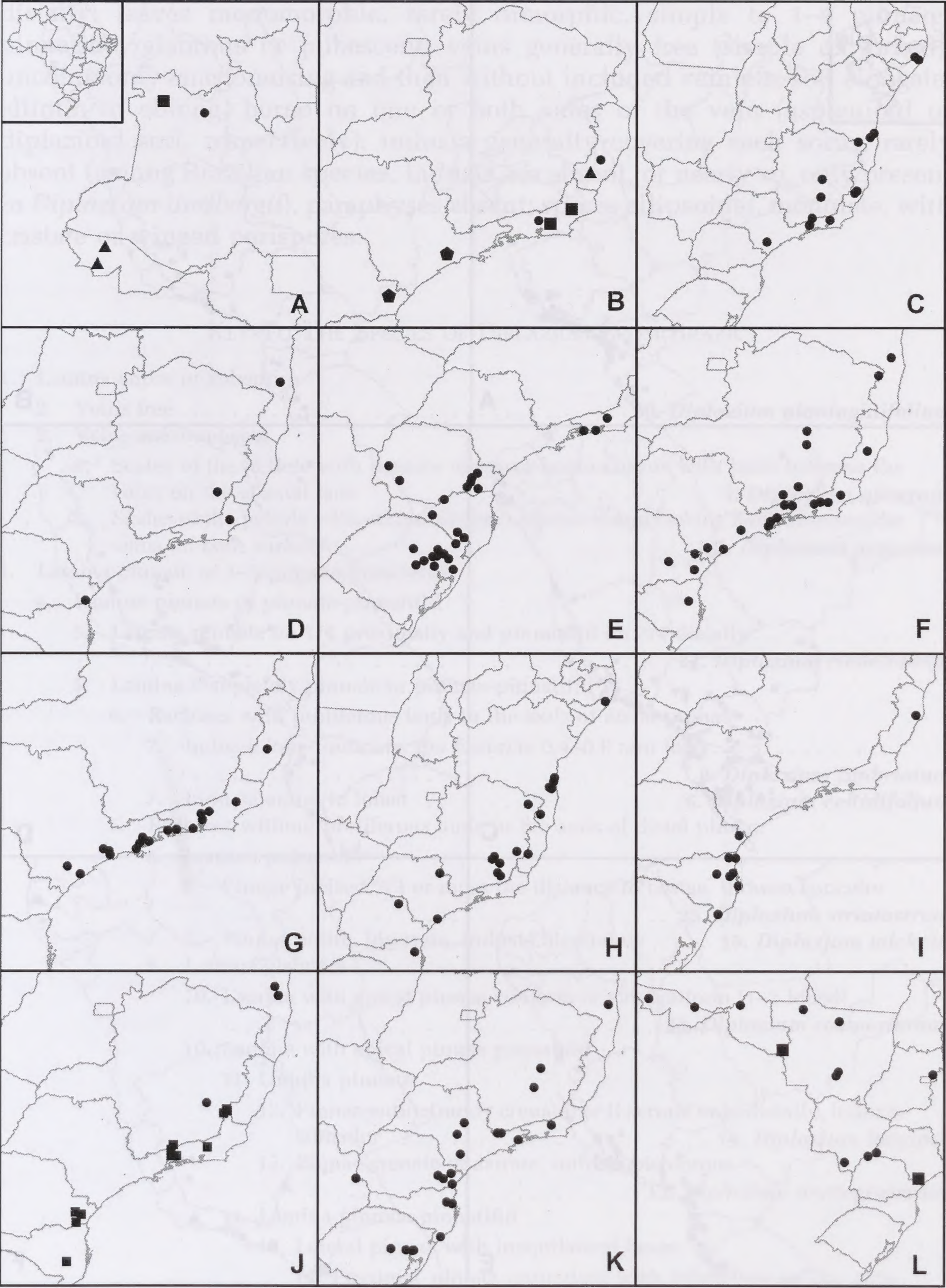


FIG. 3. Distrubution of the species: A. ● - *Diplazium aberrans*, ■ - *D. gracilescens* and ▲ - *D. praestans*; B. ● - *D. adnatum*, ■ - *D. leptochlamys*, ▲ - *D. mickelii*, ◆ - *D. tamandarei*; C. *D. brachycarpum*, *D. fimbriatum*; D. *D. leptocarpon*; E. *D. longipes*; F. *D. mutilum*; G. *D. celtidifolium*; H. *D. herbaceum*; I. *D. riedelianum*; J. ● - *D. roemerianum*, ■ - *D. rostratum*; K. *D. turgidum*; L. ● - *D. mattogrossense*, ■ - *D. petiolulatum*.

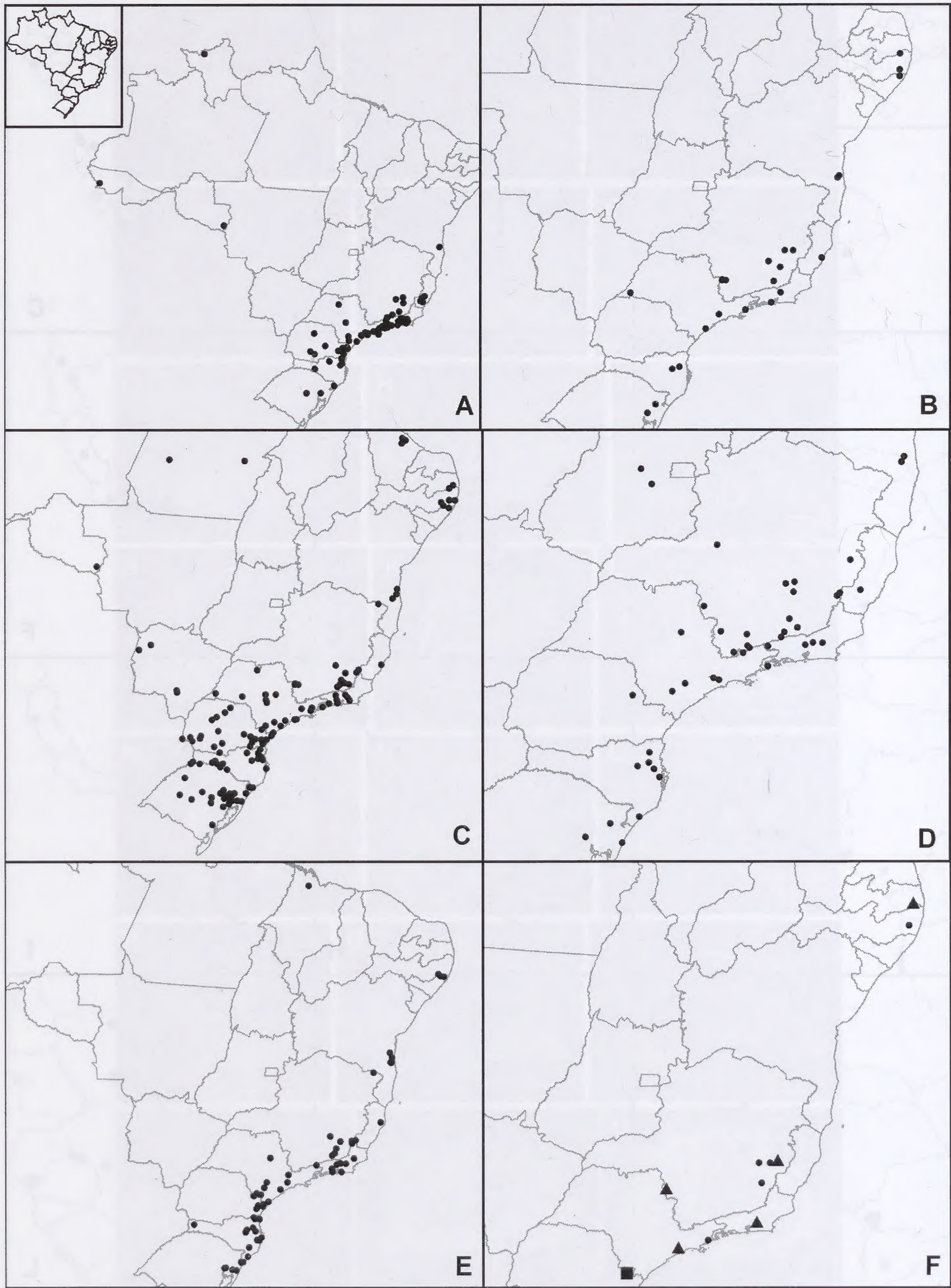


FIG. 4. Distribution of the species: A. *D. ambiguum*; B. *D. asplenioides*; C. *D. cristatum*; D. *D. lindbergii*; E. *D. plantaginifolium*; F. ● - *D. moccennianum*, ■ - *D. striatastrum*, ▲ - *D. tabalosense*.

distally; leaves monomorphic, rarely dimorphic, simple to 1–4 pinnate-pinnatifid, glabrous or pubescent; veins generally free (simple or forked), uncommonly anastomosing and then without included veinlets; sori elongate, elliptic to oblong, borne on one or both sides of the vein (asplenoid or diplazioid sori, respectively); indusia generally covering each sorus, rarely absent (among Brazilian species, indusia are absent, or nearly so, only present in *Diplazium lindbergii*), paraphyses absent; spores ellipsoidal, monolete, with cristate or winged perispores.

KEY TO THE SPECIES OF *DIPLAZIUM* FROM BRAZIL

1. Lamina entire or subentire
 2. Veins free **20. *Diplazium plantaginifolium***
 2. Veins anastomosing
 3. Scales of the petiole with dentate margins, lamina tissue with hairs between the veins on the abaxial face **1. *Diplazium aberrans***
 3. Scales of the petiole with entire margins, lamina tissue lacking hairs between the veins on both surfaces **21. *Diplazium praestans***
1. Lamina pinnate or 1–3-pinnate-pinnatifid
 4. Lamina pinnate or pinnate-pinnatifid
 5. Lamina pinnate on 1/4 proximally and pinnatifid on 3/4 distally **22. *Diplazium riedelianum***
 5. Lamina completely pinnate or pinnate-pinnatifid
 6. Rachises with proliferous buds in the axils of distal pinnae
 7. Indusia long-fimbriate, the fimbriae 0.4–0.6 mm long **8. *Diplazium fimbriatum***
 7. Indusia entire to lobed **6. *Diplazium celtidifolium***
 6. Rachises without proliferous buds in the axils of distal pinnae
 8. Lamina pubescent
 9. Pinnae incised 2/3 or more the distance to costae, indusia concolor **25. *Diplazium striatastrum***
 9. Pinnae entire, biserrate, indusia bicolorous **16. *Diplazium mickelii***
 8. Lamina glabrous
 10. Lamina with apical pinnae conform or sub conform (1–2 lobed) **23. *Diplazium roemerianum***
 10. Lamina with apical pinnae pinnatifid
 11. Lamina pinnate
 12. Pinnae entire (rarely crenate) or if serrate only distally, indusia concolor **14. *Diplazium longipes***
 12. Pinnae crenate or serrate, indusia bicolorous **15. *Diplazium mattogrossense***
 11. Lamina pinnate-pinnatifid
 13. Lateral pinnae with inequilateral bases
 14. Proximal pinnae auriculate with lobes free on the acroscopic side **19. *Diplazium petiolulatum***
 14. Proximal pinnae lacking auricle on acroscopic side **7. *Diplazium cristatum***
 13. Lateral pinnae with equilateral bases
 16. Indusia deciduous or vestigial with ca. 0.1 mm wide **13. *Diplazium lindbergii***

- 13. Indusia with 0.2–0.5 mm wide
 - 14. Proximal pinnae incised 1/5 the distance to costae **17. *Diplazium moccennianum***
 - 14. Proximal pinnae more incised
 - 15. Pinnae incised ca. 1/3 the distance to costae **18. *Diplazium mutilum***
 - 15. Pinnae incised 2/3 or more the distance to costae **26. *Diplazium tabalosense***
- 4. Lamina 2–3-pinnate-pinnatifid
 - 16. Lamina 3-pinnate-pinnatifid
 - 17. Rachises with septate and glandular hairs **9. *Diplazium gracilescens***
 - 17. Rachises glabrescent, or with septate hairs
 - 18. Laminar tissue glabrous **10. *Diplazium herbaceum***
 - 18. Laminar tissue tomentose on both surfaces **27. *Diplazium tamandarei***
 - 16. Lamina 2-pinnate-pinnatifid
 - 19. Laminar tissue pubescent **4. *Diplazium asplenoides***
 - 19. Laminar tissue glabrous
 - 20. Rachises with bicolor scales, dentate, teeth bifid . . **24. *Diplazium rostratum***
 - 20. Rachises with concolor scales, entire to dentate, teeth simple
 - 21. Indusia entire, irregularly lobed or toothed
 - 22. Petioles stramineous, costae with scales bullate abaxially, sori short, 1–2.5 mm **5. *Diplazium brachycarpum***
 - 22. Petioles brown, costae with scales flat or contorted abaxially, sori longer, 3–12mm
 - 23. Indusia membranaceous, entire or irregularly lobed **3. *Diplazium ambiguum***
 - 23. Indusia chartaceous laciniate **2. *Diplazium adnatum***
 - 21. Indusia fimbriate
 - 24. Rachises and vein scales with toothed margin abaxially **12. *Diplazium leptocarpon***
 - 24. Rachises and vein scales with margins entire abaxially
 - 25. Rachises tomentose on groove, glabrescent abaxially, indusia margins toothed to short fimbriate, fimbria 0.1mm. **28. *Diplazium turgidum***
 - 25. Rachises tomentose on both surfaces, indusia margins fimbriate, fimbria 0.2 mm **11. *Diplazium leptochlamys***

1. *Diplazium aberrans* Maxon & C. V. Morton, Amer. Fern J. 36: 93. 1946. – TYPE: COLOMBIA. Caquetá, Sucre, *Woronow and Juzepczuk 5877* (lectotype, designated by Stolze, Pacheco, and Øllgaard, 1994: LE; second step, here designated: barcode LE00008350; isotype US!, barcode US00810660).

Figs. 2A, 3A, 5A–B.

Stem erect 3.5–4 × 0.4–2 cm, apex scaly; *leaves* 40–110 cm long; *petioles* 5.7–24 × 0.2–0.5 cm, brown, scales lanceolate 2–3 × 1–1.5 mm, bicolorous, brown with margin blackish, base truncate, apices acute to acuminate, simple or bifid toothed; *lamina* 26.4–72 × 5.2–14 cm, membranaceous to chartaceous, entire, lanceolate to oblong lanceolate, base cuneate asymmetric, the apex



FIG. 5. A–B. *Diplazium aberrans*, A. detail of the lamina with anastomosing veins, B. scale with toothed margin (N.T.Silva and U.Brazão 60853); C–D. *D. adnatum*, C. detail of the adnate pinnule, D. detail of the sori showing the indusia with laciniate margins (Brade et al. 18298); E. *Diplazium ambiguum*, detail of the pinnule showing the veins and sori (Mynssen et al. 1099); F. *D. asplenoides*, pinnae (Brade 8272); G–H. *D. brachycarpum*, G. detail of the segments, showing the venation and the sori, H. detail of the sori and indusia with entire margins.

acute; *veins* anastomosed; *costae* grooved adaxially, glabrous, with lanceolate to deltate scales $2.8\text{--}4 \times 0.5\text{--}2$ mm, abaxially; *laminar tissue* glabrous adaxially, and pubescent abaxially with septate hairs 0.3–0.6 mm; *sori* oblong, diplazioid and simple, *indusia* membranaceous, pale brown, concolor, entire; *spores* with perispore winged, reticulate, surface rugulate, wings echinulate.

Distribution and ecology.—*Diplazium aberrans* occurs in Colombia, Ecuador, and Brazil. In the Brazilian territory, is restricted to the north of the Amazon at the Pirapucu Sierra at 800–1000 m, Pico da Neblina National Park, bordered with Venezuela. There is no record of recent collections.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Amazonas: Pirapucu, entre Missão Salesiana e Serra Pirapucú, 23 Jan 1966, *Silva and Brazão 60853* (NY, MG).

ADDITIONAL SPECIMENS EXAMINED.—COLOMBIA. Putumayo, Villa Garzon, 2 Sep 1993, *Cogollo et al. 6837* (JAUM, MO).

ECUADOR. Napo, rodovia Hollin-Napo 32 km, 21 Jan 1991, *Moran and Rohrbach 5147* (NY); Napo, Mushullacta, Parque Nacional Napo Galeras, 20 Apr 2003, *Croat 87847* (NY); Pastaza, Cantón, Mera, 2 May 2003, *Clark 7837* (NY); Pastaza, rio Claro, *Croat and Hannon 87054* (NY); Loreto, Faldas del volcan Smaco, oeste de Ávila Viejo, bloque 19, *Freire and Cerda 87* (NY).

Notes.—*Diplazium aberrans* examined have entire leaves. However, the specimen collected by *Werrf and Gudiño 11118* (NY) from Ecuador has pinnatifid blades, with 10–15 pairs of segments. We assumed that this is a hybrid between *Diplazium aberrans* and *D. pinnatifidum* Kunze, as labeled by Werff and Moran.

2. *Diplazium adnatum* Mynssen & Sylvestre, *Systematic Botany* 38: 910. 2013.

– TYPE: BRAZIL: Espírito Santo, Santa Maria de Jetibá, Limoeiro, 14 May 1946, *Brade et al. 18298* (holotype RB! on five sheets, barcodes RB00708131, RB00708251, RB00708252, RB00708253, RB00708254; isotypes CESJ 3346; P!, barcode P00557821; R!, barcode R000111318).

Figs. 2B, 3B, 5C–D.

Stem incomplete in specimens observed, but erect, with a scaly apex; *petioles* ca. $30 \times 1\text{--}1.5$ cm, brown, furfuraceous, with hairs ca. 0.1 mm, scales linear $0.5\text{--}0.8 \times 0.1$ mm and lanceolate $15\text{--}25 \times 1.5\text{--}3.5$ mm, concolor, brown, base truncate or ovate, apices acuminate, dentate; *lamina* ca. $140 \times 55\text{--}60$ cm, chartaceous, 1–2-pinnate-pinnatifid, lanceolate, gradually tapering to pinnatifid apex; *rachises* grooved adaxially, with catenate hairs 0.1 mm long, linear to lanceolate scales like those of the petiole on abaxial sides; *pinnae* $32\text{--}48 \times 7\text{--}16$ cm, petiolule to 0.8–1.5 cm long; *pinnules* 8–12 pairs, $5\text{--}10 \times 1.5\text{--}2.5$ cm, lanceolate, bases truncate, equilateral, with apices obtuse to acuminate, crenate; *veins* free, pinnate or bifurcate, *costae* grooved with wings 0.2–0.4 mm adaxially, scales flat or contorted; *laminar tissue* glabrous on both surfaces; *sori* (0.8) $3\text{--}12 \times 0.5\text{--}1.3$ mm, oblong, diplazioid; *indusia* persistent, chartaceous, flat, brown, laciniate; *spores* with perispore irregularly folded, reticulate, surface rugulate, wings echinulate.

Distribution and ecology.—*Diplazium adnatum* is endemic of southeastern Brazil, we suspect that it is threatened by habitat loss or quality.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Rio de Janeiro: Petrópolis, margens do Rio Piabanha, 6 Set 1873, *Glaziou* 7250 (B, P).

Notes.—*Diplazium adnatum* is a robust plant with deeply cut pinnae and densely scaly veins. The pinnae morphology, and chartaceous indusia with laciniate margins are useful for distinguishing between congeners; *Diplazium ambiguum* has membranaceous, entire, or dentate indusia; *D. macrophyllum* Desv. (from Venezuela, Colombia, Ecuador, Peru, and Bolivia) has deltate or deltate-oblong pinnae and sori with membranaceous and entire indusia; and *D. venulosum* (Baker) Diels (from Colombia, Peru, and Ecuador), has pinnae and indument similar to *D. adnatum*, but differs by entire and bicolored indusia.

3. *Diplazium ambiguum* Raddi, Syn. fil. bras. 3: 292. 1819. — *Athyrium ambiguum* (Raddi) Milde, Bot. Zeit. (Berlin) 28: 350. 1870. — *Asplenium radicans* Schkuhr var. *ambiguum* (Raddi) Baker, Fl. bras. 1 (2): 454. 1870. — TYPE: BRAZIL. Rio de Janeiro, Mandioca, *Raddi s.n.* (lectotype, designated by Pichi-Sermolli, 2005: PI; probably isotype FI).

Diplazium brasiliense Rosenst. var. *grossedentata* Rosenst., Hedwigia. 46: 108. 1907. — TYPE: BRAZIL. São Paulo, Rio Grande, Alto da Serra, *Wacket s.n.* (neotype, here designated: SPF! 67204).

Diplazium jaraguae Rosenst., Hedwigia 56: 363. 1915. — TYPE: BRAZIL. São Paulo, Monte Jaraguá, 12 May 1912, *Brade* 5215 (lectotype, here designated: S!, accession S-R-1634; isotypes NY!, barcode NY01911767; UC!, barcode UC441783; BM!, barcode BM000937839).

Figs. 2C, 4A, 5E.

Stem erect, 10–60 × 1–6 cm, apex scaly; *leaves* ca. 250 cm long, erect to arched, fasciculate; *petioles* 42–80 × 0.6–1, brown, with septate hairs ca. 0.1 mm, scales linear 0.5–15 × 0.1–0.2 mm, and lanceolate 1.2–3 × 1–3 mm, concolor, brown, base truncate, apices acuminate, entire to dentate; *lamina* 120–170 × 80–90 cm, membranaceous to chartaceous, 2-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, tomentose on both surfaces, with linear to lanceolate scales like those of the petiole on abaxial sides; *pinnae* 6–52 × 4–23 cm, petiolule to 4–11 cm long; *pinnules* 10–16 pairs, 4–18 × 1.5–7 cm, oblong to pinnatifid, bases truncate, equilateral, with apices obtuse to acuminate, entire to crenate; *veins* free, pinnate, simple or bifurcate, costae grooved with wings ca. 0.4 mm adaxially, scales flat or contorted abaxially; *laminar tissue* glabrous on both surfaces; *sori* 3–10 × 0.3–0.7 mm, oblong, diplazioid and simple; *indusia* persistent, membranaceous, brown, flat, entire or irregularly lobed; *spores* with perispore winged, reticulate, surface smooth, wings undulate.

Distribution and ecology.—*Diplazium ambiguum* occurs from north to south of Brazil and forms dense populations along the Atlantic coast in humid

montane forests at the banks of streams. In South America, this species has been reported from Venezuela, Ecuador, French Guiana, Peru, Bolivia, Argentina, and Paraguay. However, considering its high morphological variability, the distribution range needs more study.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Acre: Marechal Thamaturgo, Rio Juruá, left bank, Foz do Tejo, 7 Dec 2007, *Daly et al.* 10464 (NY). Rondônia: Vicinity of Auaris, 6 Feb 1969, *Prance* 9661 (HB, INPA). Pernambuco: São Vicente Férrer, Complexo Serra do Mascarenhas, 12 Sep 1999, *Pietrobon* 4612 (SP). Bahia: Arataca, Serra dos Lontras, 12 Feb 2005, *Matos et al.* 394 (CEPEC). Minas Gerais: São Sebastião do Paraíso, Fazenda Calado, 16 Apr 1945, *Brade and Duarte* 17976 (RB, P). Espírito Santo: Castelo, Parque Estadual do Forno Grande, trilha do Rio Manso, 3 May 2008, *Mynssen et al.* 1134 (RB). Rio de Janeiro: Angra dos Reis, Reserva da Etronuclear, 22 Sep 2004, *Mynssen* 690, 691 (RB). São Paulo: Salesópolis, Serra do Mar, estrada para Casa Grande, 3 Nov 1973, *Windisch* 514 (HB). Paraná: Antonina, Rio Copiuva, s.d., *Hatschbach* 29727 (MBM, PACA). Santa Catarina: Papanduva, Serra do Espigão, s.d., *Reitz and Klein* 12664 (PACA). Rio Grande do Sul: Santa Cruz, 15 Apr 1904, *Schoenwald s.n.* (ICN 18352).

ADDITIONAL SPECIMENS EXAMINED.—ECUADOR. Pastaza, Just south of Madre de Tierra (southwest of Puyo), riverine forest along Rio Pastaza, 22 Jan 1992, *Stolze and Stolze* 1688 (NY); Pichincha, Nanegalito, 16 Mar 1967, *Sparre s.n.* (RB).

FRENCH GUIANA. Mont Atachi Bacca, Région de L'Inini, 14 Jan 1989, *Cremers et al.* 10220 (INPA).

PERU. Pasco, Oxapampa, along Chatarra Cacazu, 10° 32S 75° 04 W, 11 Jul 2003, *Werff et al.* 18289 (NY).

PARAGUAY. Sapucay, 18 Aug 1878, *Hasser s.n.* (B)

Notes.—The original Raddi's collection in the PI herbarium, contains five unlabeled specimens and Pichi-Sermolli (2005) chose specimen number 3 as the lectotype.

Diplazium jaraguae Rosenst. and *D. brasiliense* Rosenst. var. *grossedentata* Rosenst. were described based on the lamina texture, entire or crenate margin, acute or obtuse pinnae apex, and axis pubescence. However, these characteristics are not consistent enough to treat it separately since these variations in leaf morphology and pubescence can be observed in *D. ambiguum* throughout the populations of this species. For this reason, new synonyms are being proposed.

Stolze, Pacheco, and Øllgaard (1994) described *Diplazium ambiguum* var. *dissectum* from Ecuador, which is distinguished from the typical variety by pinnules incised more than halfway to the costae. Field observations show leaf variations are probably related to the age of the individual and the habitat. We agree that an extensive study involving all congeners should be done to recognize infraspecific categories.

4. *Diplazium asplenioides* (Kunze) C. Presl, Tent. Pterid. 114. 1836. — *Allantodia asplenioides* Kunze, Linnaea 9: 72. 1834. — TYPE: PERU.

Huánuco, Cuchero, *Poeppig s.n.* (lectotype designated by Tryon and Stolze, Fieldiana, 1991: W; isolectotype B!).

Diplaziumambiguum var. *pubescens* Rosenst., Hedwigia 46: 108. 1907. — TYPE: BRAZIL. Santa Catarina, Blumenau, Passo Mansa, *Haerchen* 96 (lectotype, designated by Tryon and Stolze, 1991: S!, accession S07-12934).

Diplazium kaulfussii Hieron., Hedwigia 59 (6): 335. 1918. *Nom. nov.* to *D. obtusum* Kaulf. ex Link., Hort. Berol. 2. 73. 1833. *Nom. illeg. non* Desv. (1827). — TYPE: BRAZIL. “*In Brazil C*” (lectotype, here designated: B!, barcode B 20 0047973).

Diplazium brasiliense var. *brasiliense* Rosenst., Hedwigia. 46: 107. 1907. — TYPE: BRAZIL. Santa Catarina, Blumenau, Passo Mansa, *Haerchen* 91 (lectotype, here designated: S!, accession S-R-1625; isolectotype NY!, barcode NY00149357).

Figs. 2D, 4B, 5F.

Stem erect, $8\text{--}30 \times 1\text{--}2$ cm, apex scaly; *leaves* ca. 210 cm long, erect to arched, fasciculate; *petioles* $21\text{--}110 \times 0.5\text{--}1$ cm, brown, with septate hairs ca. 0.1 mm, scales lanceolate $1\text{--}2.5 \times 1.5\text{--}2.5$ mm, concolor, brown, base truncate, apices acuminate, entire; *lamina* $30\text{--}180 \times 20\text{--}84$ cm, membranaceous, 2-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, tomentose on both surfaces, septate hairs, with linear scales like those of the petiole on abaxial sides; *pinnae* $15\text{--}30 \times 4\text{--}12$ cm, petiolule to 6–25 mm long; *pinnules* 10–14 pairs, oblong to pinnatifid, bases truncate, equilateral, with apices acuminate to obtuse, crenate; *veins* free, pinnate, simple or bifurcate, costae grooved with wings ca. 0.4 mm adaxially, tomentose; *laminar tissue* and veins pubescent abaxially and glabrous on adaxial surface; *sori* $1.5\text{--}5 \times 0.5\text{--}1$ mm, oblong, diplazioid and simple; *indusia* persistent, membranaceous, brown, pubescent, fimbriate, fimbria with 0.1–0.2 mm; *spores* with perispore long folded, winged, reticulated, surface perforated, fimbriate folds.

Distribution and ecology.—This species has a wide distribution in Brazil, occurring from Pernambuco to Rio Grande do Sul, in the low mountainous regions, associated with shady sites near watercourses in Jamaica, Peru, and French Guiana.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Pernambuco: São Vicente Ferrer, Complexo Serra do Mascarenhas, 20 Apr 1998, *Pietrobon* 4251 (MBM, SP, SPF). Alagoas: Ibateguara, Usina Grande, Engenho Coimbra, Grota Dudé, 9 Feb 2001, *Pietrobon* 4830, 4831 (HB, UB). Bahia: Camacan, Fazenda Serra Bonita, 3 Feb 2005, *Matos et al.* 296 (CEPEC). Minas Gerais: Marliéria, Parque estadual do Rio Doce, próximo a ponte queimada, 25 Mar 2002, *A. Salino* 7967 (BHCB). Espírito Santo: Cariacica, Reserva Biológica Duas Bocas, trilha Jaqueira, 23 Jul 2008, *Labiak et al.* 4907 (MBML, RB, UPCB). Rio de Janeiro: Rio de Janeiro, Represa Camorin, Sep 1933, *Brade* 12779 (RB). São Paulo: Águas da Prata, Complexo Serra da Mantiqueira, 17 Jun 1995, *Pietrobon* 1988 (HB, MBM).

Paraná: Tunas do Paraná, Parque Estadual de Campinhos, 29 Nov 2007, *Matos 1484* (UPCB). Santa Catarina: Blumenau, Mar 1904, *Rosenstock 35* (P). Rio Grande do Sul: São José do Herval, Estrada para Walachai, 14 Nov 2006, *Mynssen and Groff 1069* (RB).

ADDITIONAL SPECIMENS EXAMINED.—PERU. Bela Vista, Solimões, 28 Jan 1924, *J. G. Kuhlmann 1289* (RB).

Notes.—*Diplazium asplenoides* is included in a complex in which the species have hairs on laminar tissue, and laciniate to fimbriate indusia. Most authors have considered *D. asplenoides* as synonym of *Diplazium expansum* Willd. (Tryon and Stolze, 1991; Stolze, Pacheco, and Øllgaard, 1994). However, we have decided to apply this binomial to the Brazilian specimens considering the type collection of *D. expansum* (B—Will), which presents entire indusia. We agree that a broad biosystematic study could clarify the real limits of the taxa.

Diplazium bonapartii Rosenst. from Peru has pinnatifid pinnules, with longer hairs on the laminar tissue, bicolor and entire or lobate indusia (vs. concolor and fimbriate indusia in *D. asplenoides*). *Diplazium kaulfussii* Hieron. is a new name for *Diplazium obtusum* Kaulf. ex Link, which is *nomen illegitimum* based on a later homonym. *Diplazium marattifolium* Christ has broader, slightly crenate pinnules, acicular, short hairs on the lamina tissue, and lanceolate scales abaxially (vs. deeply crenate pinnules, with catenate hairs and linear scales on the veins in *D. asplenoides*).

5. ***Diplazium brachycarpum*** Mynssen & Sylvestre, *Systematic Botany* 38: 910. 2013. — TYPE: BRAZIL. São Paulo: São José do Barreiro, Parque Nacional da Serra da Bocaina, 22°45'06"S, 44°37'14"W, 1484 m, 3 Oct 2006, *Mynssen, Condack and Silva 996* (holotype RB!, on three sheets, barcodes RB00708240, RB00708250, RB00708251; isotypes: NY, K).

Figs. 1C, M, 2E, 3C, 5G–H.

Stem erect, ca. 30 cm, apex scaly; *leaves* ca. 230 cm long, erect to arched, fasciculate; *petioles* ca. 90 × 1.5–2 cm, stramineous, furfuraceous, with hairs ca. 0.1 mm long, scales linear 0.5–1.2 mm × 0.1 mm, and lanceolate 8–10 × 0.4–1 mm, concolor, brown, base cordate, apices acuminate, entire to dentate; *lamina* ca. 140 × 55–60 cm, chartaceous, 2-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved and glabrous adaxially, with linear to lanceolate scales like those of the petiole on abaxial surface; *pinnae* 20–54 × 10–24 cm, petiolule to 1.5–3 cm long; *pinnules* 10–12 pairs, pinnatifid, lanceolate, bases truncate, equilateral, with apices obtuse to acuminate, crenate; *veins* free, pinnate, simple or bifurcate, costae grooved with wings ca. 0.2 mm adaxially, with scales bullate abaxially; *laminar tissue* glabrous on both surfaces; *sori* 1–2.5 × 0.8–1.5 mm, oblong, diplazioid and simple; *indusia* persistent or caducous, membranaceous, stramineous, generally bullate, entire; *spores* with perispore winged, reticulate, surface smooth, wings slightly echinulate.

Distribution and ecology.—*Diplazium brachycarpum* is an endemic and threatened species (Mynssen and Sylvestre, 2013) that occurs in the montane Atlantic Forests of southeastern and southern Brazil.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Minas Gerais: Poços de Caldas Serra de Caldas, 15 Jun 1846, *Regnell III-1473* (S, P). Santa Catarina: Faxinal dos Guedes, Biguani, 450 m altitude, 18 Jan 1945, *Reitz c 1002* (RB).

Notes.—*Diplazium brachycarpum* has a frond architecture and indument similar to *D. ambiguum*, which differs by the scales, which are flat or contorted, firm and brown (vs. bullate, very fragile and stramineous scales in *D. brachycarpum*). *Diplazium divergens* Rosenst. from Bolivia resembles *D. brachycarpum* in blade dissection and the stramineous, bullate indusia. However, *D. divergens* has larger sori with broader and persistent indusia (vs. rachises with linear and lanceolate scales, shorter, persistent, or caducous indusia in *D. brachycarpum*).

6. *Diplazium celtidifolium* Kunze, Bot. Zeit. (Berlin) 3: 285. 1845. — *Asplenium celtidifolium* (Kunze) Baker, Syn. Fil. 232. 1868. — *Athyrium celtidifolium* (Kunze) Milde, Bot. Zeit. (Berlin) 28: 353. 1870. — TYPE: VENEZUELA. Caracas, *Linden 544* (lectotype, here designed: P!, barcode P00557827; isoelectotypes P!, barcodes P00557826, P00557828, P00557829, P00557828; isoelectotype K!, barcode K000632765).

Diplazium callipteris Fée, Mém. foug. 5: 214. 1852. — *Asplenium callipteris* (Fée) Baker, Syn. Fil. 231. 1867. — TYPE: VENEZUELA. *Funck and Schlim 233*, non “*Linden 233*” (lectotype designated by Stolze, Pacheco, and Øllgaard, 1994: BM!)

Figs. 1B, 1J, 2F, 3G, 6A–D.

Stem erect, 5–10 × 2–5 cm, apex scaly; *leaves* ca. 180 cm long, arcuate, fasciculate; *petiole* 32–37 × ca. 0.8 cm, brown, with septate hairs, scales lanceolate 0.7–1.5 × 0.1–0.2 cm, concolor, brown, base truncate, apices acuminate, straight or twisted, entire to dentate; *lamina* 72–96 × 42–48 cm, chartaceous to coriaceous, pinnate, lanceolate, base obtuse, apices acute-pinnatifid; *rachises* sulcate adaxially with a double wing 0.3–0.5 mm, groove with septate hairs 0.1–0.2 mm, abaxial side with hairs septate 0.2–0.3 mm, linear scales 3–10 × 0.1–0.2 mm, and lanceolate scales 3–5 × 0.3–0.4 mm, similar to those of the petiole brown, buds present or not on the axil of the pinnae; *pinnae* 12–16 pairs, 20–24 × 3.8–4.5 cm, oblong to lanceolate, base truncate or rounded, equilateral or inequilateral, apices acute or acuminate, entire to crenate, apical pinnae pinnatifid, petiolule to 3–8 mm long; *veins* free, simple and 2–3 forked, pubescent on adaxial groove costae, and with linear scale abaxially 0.5–2.5 × 0.1 mm; *laminar tissue* glabrous on both surfaces; *sori* 5–25 × 0.3–0.5 mm, oblong, diplazioid, more than 30 pairs/pinna; *indusia* membranaceous, concolor, brown, entire to lobed; *spores* with perispore low folded, cristate, reticulate, surface and folds rugulate.



FIG. 6. A–D. *D. celtidifolium*, A detail of the pinnae showing the sori, B–D, scales of the lamina (Braga 2487); E–G. *D. cristatum*, E. Pinnae median, F. vein hair, G. scale of petiole (Mynssen 157); H. *D. fimbriatum*, proximal pinnae (F.B.Matos 236); I–L. *D. gracilescens*, I. detail of pinnule showing pubescent veins, the indusia fimbriate, J. scale of stem, K–L. septate glandular hairs (Carvalho et al. 241); M–N. *D. herbaceum*, M. detail of pinnule showing the veins and sori, N. petiole scale (Brade 8574);

Distribution and ecology.—*Diplazium celtidifolium* occurs from the Antilles to South America. In Brazil, this species occurs along the Atlantic Coast from Pernambuco to the São Paulo States.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Pernambuco: Jaqueira, Serra do Urubu, 30 May 2003, *Pietrobon 5601* (MBM, UFP). Alagoas: Ibateguara, Usina Serra Grande, Engenho Coimbra, Grotta do Dudé, 9 Feb 2000, *Pietrobon and Santiago 4826* (CEPEC, MBM, UFP) Bahia: s.d., *Blanchet 3939* (P); Arataca, Serra do Peito de Moça, RPPN Caminho das Pedras, 16 Feb 2006, *Matos 996* (CEPEC, RB). Minas Gerais: Conceição do Mato Dentro, Parque Natural do Ribeirão do Campo, 1 Aug 2002, *Mota et al. 1541* (BHCB). Espírito Santo: Santa Teresa, Reserva Biológica Augusto Ruschi, 25 Feb 2003, *R. R. Vervloet 1916* (BHCB). Rio de Janeiro: Teresópolis, Serra dos Órgãos, s.d., *Vauthier s.n.* (P). São Paulo: São José do Barreiro, Parque Nacional da Serra da Bocaina, trilha do Pico do Cruzeiro, 7 Aug 2001, *Salino et al. 7333* (BHCB).

ADDITIONAL SPECIMENS EXAMINED.—VENEZUELA. Estado Barinas, Distrito Pedraza, northeast of Alto de La Aguada, Montañas de Tierra Blanca, 18 Apr 1988, *Dorr et al. 4847* (NY).

Notes.—The holotype was previously indicated to LZ, which was destroyed (Tryon and Stolze, 1991; Stolze, Pacheco, and Øllgaard, 1994). For this reason, an isotype from P herbarium was chosen as lectotype. *Diplazium celtidifolium* has great variation in the pinnae, entire to crenate until $1/3$ towards the costae. Buds on the rachises are frequent, especially when the specimens occur in humid places. The specimens from Espírito Santo State have very scaly pinnae abaxially (e.g., *Vervloet 1916* and *Salino 2655*).

There are other species very similar to *Diplazium celtidifolium*, such as *D. longipes* Fée, distinguished by the subdimorphic leaves, entire pinnae and with linear scales abaxially on the rachis/veins; *D. obscurum* Christ from Central America with apical subconform pinnae basally auriculate; and *D. apollinaris* L'Herm. ex Fée from Antilles, distinguished by the pinnae numbers, its broadness in all dimension, pinnatifid until $3/4$ towards the costae, and pubescent on the veins and laminar tissue.

7. *Diplazium cristatum* (Desr.) Alston, J. Bot. 74: 173. 1936. — *Meniscium cristatum* Desr. in Lam., Encycl. 4: 94. 1797. — TYPE: MARTINIQUE. *Martin s.n.* (lectotype, designated by Stolze, Pacheco, and Øllgaard, 1994: P-Lam!).

Asplenium arboreum Willd., Sp. Pl. 5: 320. 1810. — *Diplazium arboreum* (Willd.) C. Presl, Tent. Pterid. 114. 1836. — TYPE: VENEZUELA. Caracas, *Bredemeyer s.n.* (lectotype, designated by Stolze, Pacheco, and Øllgaard, 1994: B-W!, barcode B-W 19892 01!; isotype B-W!, barcode B-W 19892 02).

Asplenium denticulosum Desv., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesamten Naturk. 5: 323. 1811. *non* Gaudichaud (1828). — *Diplazium denticulosum* (Desv.) C. Chr., Index Filic. 231. 1905. — TYPE: “In

America calidiorē”, *Dombey s.n.* (lectotype, designated by Stolze, Pacheco, and Øllgaard, 1994: P!).

Asplenium ambiguum Raddi, Syn. fil. bras. 3: 291. 1819. – TYPE: BRAZIL. Rio de Janeiro, Corcovado, *Raddi s.n.* (lectotype, designated by Pichi-Sermolli, 2005: PI!; probably isotype FI).

Asplenium shepherdii Spreng., Nova Acta Phys.-med. Acad. Caes. Leop.-Carol. Nat. Cur. 10: 231, t. 17, f. 5-6. 1821. – *Diplazium shepherdii* (Spreng.) Link, Hort. Berol. 2: 70. 1833. – TYPE: JAMAICA. *Shepherd s.n.* (lectotype, designated by Stolze, Pacheco, and Øllgaard, 1994: PH!, barcode PH00003368).

Asplenium anomalum Desv., Mem. Soc. Linn. Paris. 6 (3): 276. 1827. – TYPE: BRAZIL. “*Crescit in umbrosis Brasiliæ*” (type P ?) *ex descr.*

Diplazium dubium Link, Hort. Berol. 2: 71. 1833. – TYPE: BRAZIL. Rio de Janeiro, Corcovado, “*Hab. In Brasiliæ Monte Corcovado C*” (lectotype, here designated: B!, barcode B 20 0049550).

Figs. 1N, 4C, 6E–G.

Stem erect or decumbent, 5–13 × 0.5–1 cm, apex scaly; *leaves* to 30–65 cm long, arcuate, fasciculate; *petiole* 12–48 × 0.2–0.4 cm, light brown, hairs septate proximally, scales lanceolate 2.5–5 × 0.5–1.5 mm, concolor, dark brown, base truncate, apices acute to acuminate, entire to dentate; *lamina* 25–46 × 16–32 cm, chartaceous, pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* sulcate adaxially, with a double wing ca. 1 mm, glabrescent on both faces, scales linear 1–2 × 0.1 mm, without proliferous buds on the axils of distal pinnae; *pinnae* 6–8 pairs, 4–11 × 1–2.5 cm, lanceolate to oblong lanceolate, pinnatifid, base slightly cuneate to obtuse, inequilateral, apices acuminate, entire to crenate, apical pinnae pinnatifid, proximal pinnae lacking auricle on acroscopic side, petiolule to 2–10 mm long; *veins* free, simple and 1–2 forked, 18–22 pairs/ pinna, pubescent on abaxial side, hairs 0.3–0.7 mm, glabrous adaxially; *laminar tissue* glabrous on both surfaces; *sori* 5–10 × 0.3–0.5 mm, arcuate, oblong, diplazioid; *indusia* membranaceous, concolor, brown, entire; *spores* with perispore low folded, cristate, reticulate, surface and folds rugulate, slightly echinulate.

Distribution and ecology.—*Diplazium cristatum* occurs from Mexico to South America, including Antilles. It is associated with shaded and humid places and frequently found in Brazilian forests.

SELECTED SPECIMENS EXAMINED.—BRAZIL: Pará: Itaituba, Estrada Santarém-Cuiabá, BR163, Serra Mazi, sul do Pará, 18 May 1983, *Amaral et al.* 1302 (INPA, K MG, UB). Acre: Seringal Meritigal, jun1979, s.col. (HB 82862). Rondônia: Colorado do Oeste, Sítio Três Irmãos, Linha 2, km 9, rumo Escondido, *Neiva* 470 (RBR). Mato Grosso: Dourados, fazenda São Marcos, 27 Aug 1996, *Clemente* 20 (BHCB); Itapora, (PACA 7327); Itaporã, Jul 1959,

Sehnem 8060 (PACA). Mato Grosso do Sul: Corumbá, Morro Santa Cruz, nascente do córrego Bandalta, 26 Jul 2001, *M. Assis* 253 (BHCB). Ceará: Baturité, Perto do Sitio São Pedro, 20 Dec 1939, *Eugenio* 1352 (RB). Pernambuco: Ipojuca, 13 Oct 1972, *Andrade-Lima* 72-7019 (IPA, RB). Bahia: Arataca, Serra dos Lontras, 12 Feb 2005, *Matos* 407 (CEPEC) Minas Gerais: Rio Casca, margem do rio Doce, 1936, *Badini* 72 (RB). Espírito Santo: Cariacica, Reserva Biológica Duas Bocas, trilha Jaqueira, 23 Jul 2008, *Labiak et al.* 4911 (MBML, RB, UPCB). Rio de Janeiro: Guapimirim, Estação Ecológica do Paraíso, Trilha após a Represa no Rio Paraíso, caminho do encanamento, 3 Sep 2007, *Mynssen* 1070 (RB). São Paulo: Bananal, Estação Ecológica do Bananal, rio das cobras, 12 Sep 2001, *Salino* 7530 (BHCB). Paraná: Bateias, 10 Mar 1993, *Cislinski* 262 (UPCB). Santa Catarina: Blumenau, Aug 1904, *Haerchen* s.n. (BM, HBR 26498). Rio Grande do Sul: São José do Herval, 14 Nov 2006, *Mynssen and Groff* 1068 (RB).

ADDITIONAL SPECIMENS EXAMINED.—MEXICO. *Schaffner* 267 (RB).

COSTA RICA. Cartago, 1 Jul 1976, *Croat* 36783 (RB).

PANAMA. Quebrada San Antonio, 26 Jan 1974, *Nee* 9458 (RB).

GUADALOUPE. *L'Hermnier* s.n. (RB 215063).

PARAGUAY. Alto Estância Rio Bonito, 30 Aug 1994, *Zardini and Vera* 40821 (RB); Alto Paraná, Reserva Biológica Itabó, 24 May 1989, *Krapovikas and Cristóbal* 43185 (CTES, K).

Notes.—*Diplazium cristatum* is included in a complex whose species are very similar and generally differentiated by pinna shape and sorus position. According to Tryon and Stolze (1991), *D. cristatum* is the central species of this complex.

Diplazium werckleanum Christ, which occurs in southern Mexico, Central America, and Colombia, has entire to crenate pinnae, with the basiscopic sides deeply cuneate, longer petiolule, and entire to lobate indusia (vs. pinnatifid to crenate pinnae, basiscopic side obtuse to slightly cuneate, shorter petiolule, and entire indusia in *D. cristatum*). *Diplazium bombonasae* Rosenst. (Peru, Ecuador, and Bolivia) can be distinguished from *D. cristatum* by the submarginal sori, falcate pinnae, acute apices, and acroscopic sides auriculate or lobate. *Diplazium lonchophyllum* Kunze (Mesoamerican) has ascending pinnae, that are longer acuminate, and narrower than *D. cristatum*, and deeply incised on $2/3$ of the margin, a pair of the segments free proximally. The non-scaly stem at the apex and prominent veins abaxially can distinguish *Diplazium prominulum* Maxon. *Diplazium caracasana* (Willd.) T. Moore (Peru and Ecuador) has a higher number of pinnae pairs; at least seven basal pinnae are incised to $1/2$ of the margin.

8. *Diplazium fimbriatum* Mynssen & F. B. Matos. — TYPE: BRAZIL. Bahia: Camacan, Serra Bonita, Fazenda Uiraçu, trilha da Bapeba, 15°23'30"S, 39°33'55"W, 890 m, 22 Oct 2009, *C. M. Mynssen and F. B. Matos* 1167 (holotype: RB!, on five sheets, barcodes RB00816062, RB00816065, RB00816066, RB00816067, RB00816068; isotypes: CEPEC, MO, NY, UC, UPCB).

Figs. 1D, 3C, 6H.

Stem 20–40 × 1–1.5 cm, ascending to erect, apex scaly; *leaves* to 150–180 cm long, erect to arched, fasciculate; *petioles* 55–80 × 0.8–1 cm, brown, with septate hairs 0.1–0.3 mm, scales lanceolate 1.2–2 × 0.1–0.3 cm, concolor, brown, base truncate, apices acuminate, sinuate, entire to dentate; *lamina* 94–149 × 40–65 cm, chartaceous, 1-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* sulcate with a double wings 0.2–0.5 mm, with septate hairs in adaxial grooves, linear scales 1.5–2.5 × 0.1–0.2 mm, and lanceolate scales 1.5–4 × 0.5–0.8 mm on both surfaces, with proliferous buds on the axils of distal pinnae; *pinnae* 6–14 pairs, 28–37 × 3–5.5 cm, oblong-ovate to deltate, bases truncate or round, equilateral or inequilateral, apices acuminate, crenate to slightly serrate, incised 2/3 or less to the costae, apical pinnae pinnatifid, petiolule to 0.4–1.2 cm long; *veins* free, pinnate, simple or furcate, with linear scales 0.8–1 × ca. 0.1 mm; *laminar tissue* glabrous on both surfaces; *sori* 5–8 × 0.3 mm, oblong, diplazioid and simple; *indusia* commonly persistent, membranaceous, brownish, long-fimbriate, fimbriae 0.4–0.6 mm long; *spores* with perispore winged, reticulate, surface smooth, wings undulate.

Distribution and ecology.—*Diplazium fimbriatum* is a threatened and endemic species (Mynssen and Matos, 2012). Restricted to the humid montane forests of the Brazilian South and Southeast (Paraná, Bahia, Minas Gerais, and Rio de Janeiro States), where it grows in deep shade and along stream banks, at 250–1200 m. *Diplazium fimbriatum* occasionally shares its habitat with *D. celtidifolium*, *D. lindbergii*, and *D. mutilum*, which could favor the process of hybridization.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Bahia: Camacan, Serra Bonita, Fazenda Paris, trilha às margens de córrego, 15°30'52"S, 39°40'27"W, 250m, 21 Oct 2009, *Mynssen and Matos 1154, 1155* (CEPEC, RB). Rio de Janeiro: Itatiaia, Parque Nacional do Itatiaia, lote 18, Sep 1934, *Brade 14080* (RB). Minas Gerais: Araponga, Parque Estadual da Serra do Brigadeiro, Serra da Gramma, 27 May 2000, *Salino et al. 5531* (BHCB, NY). Paraná: Guaratuba, Fazenda Hatschbach, 27 Jul 1960, *Duarte 5324* (RB).

Notes.—There are at least four similar congeneric species: *Diplazium costale* (Sw.) C. Presl var. *robustum* (Sodirol) Stolze, endemic to Ecuador (Stolze, Pacheco, and Øllgaard, 1994), with abundant costal scales, robust falcate sori closer to the costae, and entire indusia (vs. delicate oblong sori with fimbriate indusia in *D. fimbriatum*); *Diplazium macrophyllum* Desv. (Venezuela, Colombia, Ecuador, Peru, and Bolivia), which differs by the broader pinnae (9–22 cm), attenuate or acuminate segments, and lanceolate to deltate scales abaxially on the veins (vs. 3–5.5 cm pinnae, obtuse to acute apices, and filiform to linear scales in *D. fimbriatum*); *Diplazium apollinaris* (Guadaloupe) has lamina architecture and fimbriate indusium very similar to *D. fimbriatum*, but lacking buds on the rachis (vs. rachis with buds in *D. fimbriatum*). *Diplazium ballivianii* Rosenst. (Bolivia) has hairs on the laminar tissue, and entire indusia

(vs. laminar tissue glabrous on both surfaces, and fimbriate indusia in *D. fimbriatum*).

9. *Diplazium gracilescens* (Mett.) Moore ex R. Knuth, Repertorium Specierum Novarum Regni Vegetabilis, Beihefte 43: 34. 1926. – *Asplenium gracilescens* Mett., Ann. Sci. nat. 2: 237. 1864. – TYPES: COLOMBIA. Nova Granada, Ocaña, *Engel 250* (lectotype, here designated: B!, barcode B 20 0047752; isolectotypes B, barcodes B 20 0047748, B 20 0047749, B 20 0047751, B 20 0047753, B 20 0047754, B 20 0047755, B 20 0047756).

Figs. 3A, 6I–L.

Stem decumbent, 4–10 × 0.7–1 cm, apex scaly; *leaves* ca. 90 cm long, fasciculate; *petioles* 30–32 × 0.2–0.4 cm, brown, with septate hairs ca. 0.1 mm long, scales deltoide 6–8 × 1.5–3 mm, concolor, brown, lanceolate, base truncate, apices acuminate, entire to dentate; *lamina* 46–50 × 24–30 cm, 3-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, with septate 0.2–0.4 mm, and glandular hairs ca. 0.1 mm; *pinnae* ca. 11 pairs, 16–22 × 10–14 cm, petiolule to 7–10 mm long; *pinnules* 10–12 pairs, 4–6 × 1.8–2, lanceolate, bases truncate, equilateral, obtuse to acuminate; *pinnules* 3rd order 0.8–1.2 × 0.3–0.5 cm, 6–8 pairs, elliptic to oblong, entire to crenate; *veins* free, pinnate, simple or bifurcate, 5–7 pairs, costae grooved adaxially, with wings; *laminar tissue* glabrous on both surfaces; *sori* 1.5–4 × 0.2–0.4 mm, elliptic, simple, 2–4 per segment; *indusia* persistent, membranaceous, brown, erose to fimbriate; *spores* ellipsoidal, monolete.

Distribution and ecology.—*Diplazium gracilescens* occurs in Colombia, Venezuela, French Guiana, Surinam, and Guyana. In Brazil this species is known only from the Pico da Neblina National Park at 1080 m elevation in the Amazon State.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Amazonas: São Gabriel da Cachoeira, Parque Nacional do Pico da Neblina, trilha para a cachoeira do Anta entre o acampamento Bebedouro Novo e Cuiabixi, 27 Dec 2004, *Carvalho et al.* 241 (BHCB, INPA).

ADDITIONAL SPECIMENS EXAMINED.—GUYANA. Potaro-Siparuni, Pakaraima, Mtns, Manaparu creek, 610m, 30 Oct 1994, *Mutchnick 289* (INPA).

FRENCH GUIANA. Cayenne, Montanha de L'Inini, 28 Aug 1885, *Cremers 9137* (INPA); id., Monte Atachi Bacca, 20 Jan 1989, *Cremers 10318* (INPA).

Notes.—*Diplazium gracilescens* belongs to a complex that includes eight taxa: *Diplazium alienum* (Mett.) Hieron., *D. buchtienii* Rosenst., *D. divisissimum* (Baker) Christ, *D. fuscopubescens* (Hook.) T. Moore, *D. lehmannii* Hieron., *D. wilsonii* (Baker) Diels, *D. wilsonii* var. *brunneoviridi* (Jenmann) Proctor, which have glandular hairs on the leaves. Authors of different floras treated most of them separately. This group needs a monographic study to show the real morphological limits of each taxon.

10. *Diplazium herbaceum* Fée, Crypt. vasc. Brésil 1: 80, t. 23, f. 1. 1869. – TYPE: BRAZIL. Rio de Janeiro, *Glaziou 2061*, non “2062” (lectotype,

designated by Arana, Mynssen, and Ponce, 2017: P!, barcode P00632631; isoelectotypes P!, barcodes P00222122, P00222123, B!, barcode B 20 0047851, K!, barcodes K000632771, K000632772, NY! fragment, barcode NY01163487;).

Asplenium glaziovii Baker, *Flora Brasiliensis* 1 (2): 455.1870. – TYPE: BRAZIL. Rio de Janeiro, *Glaziou 2061. Nom. illeg.*

Diplazium delicatulum Fée, *Crypt. vasc. Brésil* 2. 49. 1873. – TYPE: BRAZIL, Rio de Janeiro, *Glaziou 5303* (lectotype, here designated: P!, barcode P00696330; isoelectotypes P!, barcodes P00696329, P00541495, P00541496, P00541497, B!, barcode B 20 0047255).

Figs. 1K, 2G, 3H, 6M–N.

Stem horizontal or elongated, $8\text{--}10 \times 1\text{--}1.2$ cm, apex scaly; *leaves* ca. 120 cm long, arched; *petioles* $42\text{--}92 \times 0.4\text{--}1$ cm, brown, scales lanceolate $4\text{--}8 \times 1\text{--}2$ mm, concolor, brown, base cordate, apices acuminate, twisted, margins entire to discontinuous with projections; *lamina* $72\text{--}130 \times 54\text{--}64$ cm, membranaceous to chartaceous, 2–3-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, glabrescent or with catenate hairs and linear scales $0.5\text{--}1.5 \times 0.1$ mm sparsely on both surfaces; *pinnae* $20\text{--}36 \times 10\text{--}22$ cm, petiolule to 1–2.5 cm long; *pinnules* 9–16 pairs, $5\text{--}10 \times 1\text{--}2.5$ cm, oblong, bases truncate, equilateral, proximal with apices obtuse or acute, distal with apices acuminate, crenate; *pinnules* 3rd order $1\text{--}2.5 \times 0.5\text{--}1$ cm, elliptic to oblong, entire to crenate; *veins* free, simple or bifurcate, costae with wings $0.2\text{--}0.4$ mm; *laminar tissue* glabrous on both surfaces; *sori* $2\text{--}4 \times 0.5\text{--}1$ mm, oblong, simple or diplazioid; *indusia* persistent, membranaceous, light brown, laciniate; *spores* with perispore cristate, not reticulate, surface rugulate, folds irregularly undulate.

Distribution and ecology.—This species occurs in the southeast in the Atlantic Forest Brazilian, and Argentina.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Rio de Janeiro: Mangaratiba, Reserva Rio das Pedras, trilha do Corisco, 6 Jan 2000, *Mynssen 304* (RB). Paraná: Campo Largo, 10 Mar 1993, *Cislinski 263* (UPCB). Santa Catarina: Lages, s.d., *Spannagel 198* (SPF, SP). Rio Grande do Sul: Farroupilha, Salto Ventoso, 7 Apr 1953, *Sehnem 6440* (PACA).

ARGENTINA. Misiones. Dpto. G. M. Belgrano: 2 km. al sur de Bernardo de Irigoyen, naciente del río Pepirí Guazú, 15 Oct 1996, *Morrone et al. 1422* (SI);

Notes.—Fée (1869) described *Diplazium herbaceum* and *D. leptochlamys*, adding them to the same collection, *Glaziou 2062*. He later corrected his mistake (Fée 1872–73) and cited *Glaziou 2061* as the type of *D. herbaceum*. *Diplazium delicatulum* is a synonym of *D. herbaceum* because the stronger petiole and more membranaceous and acuminate pinnules are not enough to distinguish between these species. *Diplazium tamandarei* Rosenst. has

laminar architecture that is similar but it is pubescent, with pinnules more deeply incised, and fimbriate indusia (vs. glabrous lamina tissue and entire indusia). *Diplazium gomezianum* C.D. Adams from Mexico, Costa Rica, and Panama, has catenate and glandular hairs on the rachises and veins (vs. glabrescent rachises and veins with only catenate hairs in *D. herbaceum*). We consider these species to be related.

11. *Diplazium leptochlamys* Fée, Crypt. vasc. Brésil 1: 80, t. 22, f. 1. 1869. — TYPE: BRAZIL. Rio de Janeiro, Petrópolis, Serra da Estrela, *Glaziou* 926 (lectotype, here designated: P!, barcode P00541470; isolectotypes P!, barcodes P00696317, P00696318).

Diplazium leptochlamys var. *leptorachis* Fée, Crypt. vasc. Brésil 1: 79, t. 22, f. 1. 1869. — TYPE: BRAZIL. Rio de Janeiro, *Glaziou* 1673 (lectotype, here designated: P!, P01574590; isolectotypes P, barcodes P00228464, P00228395, P00228396; K!, barcode K000632779, S!, accessions 05-10590, 05-10592).

Figs. 2H, 3B.

Although missing from the specimens, label information indicates that the stem is erect, with a scaly apex; *leaves* ca. 160 cm long, arched; *petioles* ca. 70 × 0.4–1 cm, brown, with septate hairs ca. 0.1 mm long, scales linear 0.5–15 × 0.1 mm, and lanceolate 1–10 × 0.1–0.2 mm, concolor, brown, lanceolate, base truncate, acuminate, entire; *lamina* membranaceous to chartaceous, 2-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, tomentose on both surfaces, catenate hairs, with linear 0.7–1.5 × ca. 0.1 mm, and lanceolate scales 2.5 × 1–2 × 1–2 mm; *pinnae* 15–38 × 5–12 cm, petiolule to 0.5–1.5 cm long; *pinnules* 10–16 pairs, oblong, bases truncate, equilateral, with apices acuminate to obtuse, crenate; *veins* free, pinnate, simple or bifurcate, costae grooved adaxially, with wings ca. 0.2 mm; *laminar tissue* glabrous on both surfaces; *sori* 3–10 × 0.3–0.7 mm, oblong, diplazioid and simple; *indusia* membranaceous, brown, flat, fimbriate, fimbria 0.2 mm; *spores* with perispore winged, reticulate, surface smooth, folds slightly echinulate.

Distribution and ecology.—Currently, this species is known only from the Atlantic Forest, where it occurs in preserved, and humid forests.

ADDITIONAL SPECIMENS EXAMINED.—BRAZIL. Rio de Janeiro: Cachoeiras de Macacu Parque Estadual dos Três Picos, 9 MAY 2013, *Damasceno & Wenderroschy* 617 (RB).

Notes.—Based on molecular analyses (Mynssen *et al.*, unpublished data) with material from the same type locality, this taxon was recovered as monophyletic and sister to the *D. ambiguum* clade. Furthermore, the indument (hairs and scales), and the fimbriate indusia (fimbriae 0.2 mm) can be used to separate it from *D. ambiguum*.

Diplazium leptochlamys var. *leptochlamys* was described over two syntypes (*Glaziou* 926, 2062). Fée mistakenly used the collection *Glaziou* 2062 on the protologue of *D. herbaceum*; therefore, we chose *Glaziou* 926 as lectotype.

- 12. *Diplazium leptocarpon*** Fée, Crypt. vasc. Brésil 1: 80, t. 23, f. 2. 1869. —
 TYPE: BRAZIL. Rio de Janeiro, *Glaziou* 2330 (lectotype, here designated: P!,
 barcode P00228390; isoelectotype P, barcode P00228391, K!, barcode
 K000632770; S!, accession 05-10588).

Figs. 1G, 2I, 3D, 7A–D.

Stem erect, 5–10 × 0.7–2 cm, apex scaly; *leaves* 120–190 cm long, erect to arched, fasciculate; *petioles* 46–73 × 0.4–0.8 cm, dark-brown, with septate hairs ca. 0.1 mm, scales linear 0.9–2 × ca. 0.1 mm, and scales lanceolate 0.5–10 × 1–2 mm, concolor, brown, base truncate to cordate, apices acuminate, simple toothed; *lamina* 61–110 × 22–64 cm, membranaceous to chartaceous, 1–2-pinnate-pinnatifid, lanceolate to deltoid, gradually tapering to a pinnatifid apex, rarely with proliferous buds on the axils of distal pinnae; *rachises* grooved adaxially, tomentose on both surfaces, with linear to lanceolate scales like those of the petiole on abaxial sides; *pinnae* 15–30 × 3.5–8.5 cm, 5–10 pairs, incised 1/3–2/3 from the margin, petiolule to 3–15 cm long; *pinnules* 3–6 × 0.6–1.2 cm, 10–16 pairs, oblong, base truncate, equilateral, with apex acute to obtuse, entire to incised-crenate; *veins* free, pinnate, simple or bifurcate, 5–9 pairs, costae grooved adaxially, with wings ca. 0.2 mm; *laminar tissue* glabrous on both surfaces; *sori* 2–4.5 × 0.4–0.6 mm, oblong, diplazioid and simple; *indusia* membranaceous, brown, fimbriate, fimbria with 0.3–0.7 mm; *spores* with perispore winged, reticulate, surface and folds coarsely echinulate.

Distribution and ecology.—*Diplazium leptocarpon* is endemic to the Brazilian coastal forest, in humid and preserved forests, where it occurs from southern Bahia to Paraná State.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Bahia: Camacã, RPPN Serra Bonita, 3 Mar 2006, *Matos* 1081 (MBM). Minas Gerais: Ouro Preto, Parque Estadual do Itacolomi, estrada para o Cibrão, 24 Mar 2004, *Mynssen* 569 (RB); Espírito Santo: Santa Teresa, Nova Lombardia, terreno do Furlani, 13 Jul 2007, *Labiak* 4077, 4078 (RB, UPCB); Rio de Janeiro: Itatiaia, trilha dos Três Picos, 31 May 2006, *Mynssen et al.* 960 (RB). São Paulo: Alto da Serra, 14 Jul 1912, *Brade* 5243 (HB). Paraná: Morretes, Estrada da Graciosa, caminho para o rio Cascata, 14 Feb 1993, *Cislinski* 256 (RB, UPCB); Morretes, Pico do Marumbi, 12 Aug 1999, *Kozera* 1158 (MBM); Ponta Grossa, Parque Estadual de Vila Velha, braço esquerdo da Fortaleza, adjacente ao córrego, 8 Jan 2005, *Schwartsburd* 599 (RB, UPCB); Ponta Grossa, Parque Estadual de Vila Velha, braço esquerdo da Fortaleza, adjacente ao córrego, 29 Oct 2005, *Schwartsburd* 963 (RB, UPCB).

Notes.—*Diplazium leptocarpon* is included in a complex of at least five species, which are distributed from Mexico and the Antilles to South America: *Diplazium altissimum* (Jenman) C.Ch., *Diplazium lherminieri* Hieron., *Diplazium diplazioides* (Klotzsch and H. Karst. ex Klotzsch) Alston,

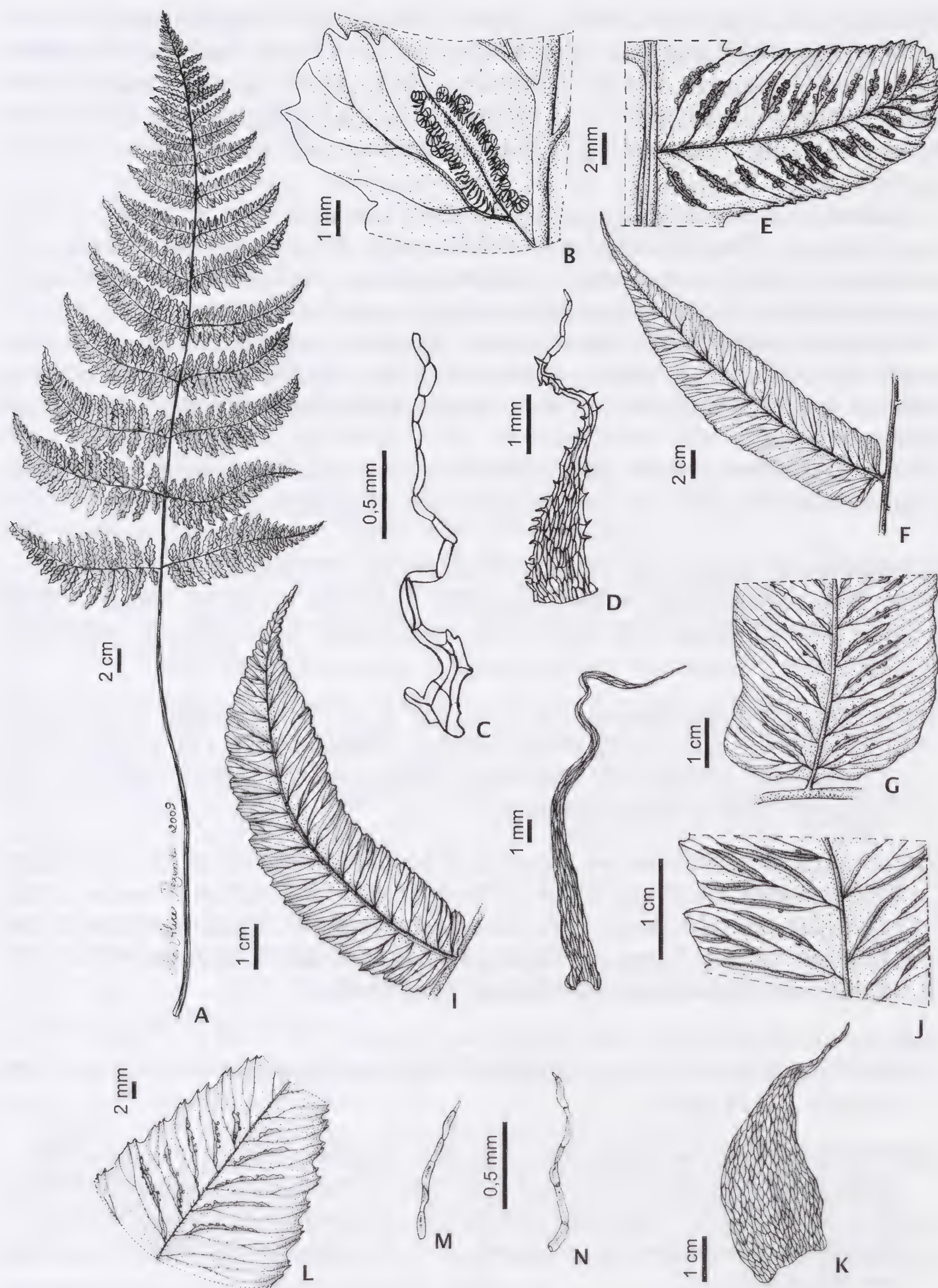


FIG. 7. A–D. *Diplazium leptocarpon*, A. leaf, B. detail of the pinnule showing the veins and sori, C. scale of rachis, D. scale of stem (Mynssen *et al.* 569); E. *D. lindbergii*, detail of segment showing the sori (Mynssen *et al.* 969); F–H. *D. longipes*, F. pinnae median, G. detail of lamina base, H. scale of stem (Mynssen and Bovini 1144); I–K. *D. mattogrossense*, I. pinnae median, J. detail showing sorus and veins, K. petiole scale (M. R. Silva 1545); L–N. *D. mickelii*, L. detail of pinnae, M–N, hairs of pinnae (Brade 19821).

Diplazium moritzianum Stolze. These species are distinguished by the morphology of the pinnules, the consistency of lamina, buds on the rachis and indusial margin. The Brazilian specimens rarely present buds on the rachis at the apical pinnae (e.g., *Matos 1081*). As highlighted by Mickel and Smith (2004), this complex is in need of a biosystematic study that includes all species.

Diplazium lherminieri, from the Antilles, has narrower pinnules, a more scaly petiole and rachis, and long toothed scales, simple or bifid toothed, with proliferous buds on the axils of distal pinnae (vs. short toothed scales, generally simple teeth, and proliferous buds rare in *D. leptocarpon*).

Diplazium altissimum, from Mexico, Central America and Antilles, has broader (0.5–0.8 mm), bulate, entire to shorter fimbriate indusia, with the fimbriae 0.1–0.2 mm (vs. flat and longer fimbriate indusia in *Diplazium leptocarpon*).

Diplazium diplazioides has glabrous rachis grooves and in *Diplazium moritzianum* the pinnules are less incised than in *D. leptocarpon*.

13. *Diplazium lindbergii* (Mett.) Christ, Prim. fl. Costaric. 3: 27. 1901. – *Asplenium lindbergii* Mett., Ann. Sci. Nat. Bot. 5 (2): 36. 1864. – TYPE: BRAZIL. *Lindberg 543* (lectotype, designated by Lellinger, 1977: B!, barcode B 20 0048180; isoelectotype K!, barcode K000632769).

Asplenium subnudum Karsten, Fl. Columb. 2: 93, t. 148. 1865. – *Diplazium lindbergii* var. *subnuda* (Karsten) Hieron., Hedwigia 47: 214. 1908. – TYPE: COLOMBIA. *Karsten s.n.* (lectotype, designated by Stolze, Pacheco, and Øllgaard, 1994: L; isoelectotype W)

Gymnogramme grandis Baker, Syn. Fil. 377. 1868. – *Diplazium grande* (Baker) C.Chr., Index Fil. Supp. 3: 74. 1934. – TYPE: VENEZUELA. Caracas. April 1842, *Linden 540* (lectotype, here designated: K!, barcode K000632750, isoelectotype BM!, barcodes BM000937829, BM000937830, BM000937831, P!, barcode P00696331, P00696332, P00541486;).

Gymnogramma attenuata Fée, Crypt. vasc. Brésil 1: 81, t. 24, f. 2. 1869. – TYPE: BRAZIL. Rio de Janeiro, *Glaziou 1776* (lectotype, here designated: P!, barcode P00541504).

Asplenium induratum Christ, Bull. Soc. Roy Bot. Belgique 35 (1): 201. 1896. – *Diplazium induratum* (Christ) Diels, Nat. Pflanzenfam. 1 (4): 226. 1899. – TYPE: COSTA RICA. Limón, Cordilheira de Talamanca, Tsâki, *Tonduz s.n.* (lectotype, designated by Lellinger, 1977: P!; isoelectotype BR). *Nom. illeg., non* Hooker (1861).

Diplazium brasiliense Rosenst. var. *glabriuscula* Rosenst. Hedwigia. 46: 108. 1907. – TYPE: BRAZIL. São Paulo, Campinas, Toledo, *Ulbricht 42* (lectotype, here designated: R!, barcode R000206205). *Syn. Nov*

Figs. 1Q, 2J, 4D, 7E.

Stem erect, 5–10 × 0.7–1.5 cm, apex scaly; *leaves* 90–220 cm long, erect to arched, fasciculate; *petiole* 44–100 × 0.7–1.5 cm, blackish brown proximally, with septate hairs, scales lanceolate 10–25 × 0.5–3 mm, concolor, brown, base truncate or cordate, apices acute to acuminate, twisted, entire; *lamina* 55–160 × 26–70 cm, carthaceous to sub-coriaceous, lanceolate, pinnate-pinnatifid, base obtuse, acuminate, gradually tapering to a pinnatifid apex; *rachises* sulcate adaxially with a double wing ca. 0.1 mm, with hairs septate 0.2–0.4 mm, and scales linear 1–1.5 × ca. 0.1 mm on both side, without proliferous buds in the axils of distal pinnae; *pinnae* 14–30 pairs, 20–36 × 3.5–5 cm, oblong, base truncate, equilateral, apices acuminate, incised to 1/3–2/3 of the margin, serrate, apical pinnae pinnatifid, petiolule to 2–5 mm long; *veins* free, simple and forked, straight, with hydathodes, pubescent, and with linear scales abaxially; *laminar tissue* glabrous on both surfaces; *sori* 1.5–4 × ca. 0.5 mm, oblong, straight, diplazioid and simple, more than 25 pairs/ pinna; *indusia* deciduous or vestigial with ca. 0.1 mm wide, membranaceous, concolor, light brown, entire or irregularly short laciniate; *spores* with perispore winged, reticulate, surface rugulate, folds slightly echinulate.

Distribution and ecology.—*Diplazium lindbergii* has a wide distribution from southern Mexico, Central America, the Antilles, Colombia, Venezuela, Ecuador, Peru, Bolivia, and Argentina. In Brazil it occurs from the northeast to the southeast/south.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Goiás: Anápolis, 16 Oct 1956, *L. B. Smith* 4746 (HB). Bahia, Arataca, Serra dos Lontras, 12 Feb 2005, *Matos et al.* 392 (CEPEC). Minas Gerais: Caparaó, Parque Nacional do Caparaó, 30 Apr 1988, *Krieger* 113 (CESJ); Espírito Santo: Castelo, Parque Estadual do Forno Grande, trilha do Rio Manso, 20 Jul 2008, *Labiak et al.* 4866 (MBML, RB, UPCB). Rio de Janeiro: Itatiaia, lote 21 após a lagoa azul Sitio do Belga, 12 Jul 2006, *Mynssen et al.* 969 (RB). São Paulo: São José do Barreiro, Estrada principal, 3 Oct 2006, *Mynssen et al.* 1002 (RB). Paraná: Jaguariaíva, 11 May 1914, *Dusén* 14959 (BM). Santa Catarina: Araranguá, Serra da Pedra, 7 Dec 1943, *Reitz* 429 c (RB). Rio Grande do Sul: Montenegro, Linha São Pedro, s.d., *Sehnem* 3308 (JPB, PACA).

ADDITIONAL SPECIMENS EXAMINED.—COLOMBIA. Bogotá, “*Cataractam Tequendamam*” 8–11 Dec 1852, *Holton* 29 (K).

VENEZUELA. Caracas, Apr 1842, *Linden* 540 (K, BM, P).

ECUADOR. Pichincha, Reserva Florística Ecológica Rio Guajalito, 0°13'S e 78° 48' W, 1800–2200 m alt., 24 Sep 1998, *Zak and Jaramillo* 3832 (INPA).

Notes — Due to the analyses of the type collection of *Diplazium brasiliense* Rosenst. and their infraspecific taxa, we consider *D. brasiliense* var. *glabriuscula* to be a synonym of *D. lindbergii*.

14. *Diplazium longipes* Fée, Crypt. vasc. Brésil 1: 77, t. 21, f. 2. 1869. — TYPE: BRAZIL. Rio de Janeiro, Angra dos Reis, Jacuacanga, *Glaziou* 2346 (lectotype, here designated P!, barcode P00557791; isoelectotypes P!, barcodes P01581983, P01581984, P00557789, P00557790, P00541498,

P00541499, P00541500, K!, barcode K000632777, B! barcodes B 20 0048238, B 20 0048239).

Figs. 2K, 3E, 7F–H.

Stem erect, $1\text{--}2.5 \times \text{ca. } 2$ cm, apex scaly; *leaves* 130–160 cm long, arched, fasciculate; *petiole* $35\text{--}55 \times 0.5\text{--}0.8$ cm, blackish brown proximally, with hairs simple and catenate, with linear $4\text{--}10 \times 0.2\text{--}2$ mm, and lanceolate scales $15\text{--}25 \times 1\text{--}1.5$ mm, concolor, brown, base truncate or cordate, apices acute to acuminate, twisted, entire to dentate; *lamina* $58\text{--}64 \times 22\text{--}36$ cm, membranaceous, lanceolate, pinnate, base obtuse, acute, gradually tapering to a pinnatifid apex; *rachis* sulcate adaxially with a double wing $0.2\text{--}0.3$ mm, with hairs catenate $0.2\text{--}0.4$ mm, and scales linear $2\text{--}7 \times 0.1\text{--}0.2$ mm on both surfaces, without buds proliferous on the axil of the pinnae; *pinnae* 10–14 pairs, $17\text{--}25 \times 3\text{--}4$ cm, oblong, base truncate or rounded, equilateral, apices acuminate, entire rarely crenate or serrate distally, apical pinnae pinnatifid, petiolule to 2–4 mm long; *veins* free, simple and 2–3 forked, arcuate, with hydathodes or not, pubescent, and with linear scales abaxially; *laminar tissue* glabrous on both surfaces; *sori* $4\text{--}17 \times 0.3\text{--}0.5$ mm, oblong, diplazioid, more than 25 pairs/pinna; *indusia* membranaceous, concolor, light brown, entire, rarely laciniate; *spores* with perispore winged, not reticulate, surface smooth, folds slightly echinulate.

Distribution and ecology.—We consider *Diplazium longipes* to be endemic to southeastern Brazil; it occurs in wet montane forests.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Espírito Santo: Santa Maria de Jetibá, Limoeiro, s.d., *Brade et al.* 18286 (NY, RB). Rio de Janeiro: Mangaratiba, Reserva Rio das Pedras, trilha para o Cambucá, 10 Feb 2009, *Mynssen and Bovini* 1144 (RB). São Paulo: Caraguatatuba, 28 Jul 1983, *Pirani* 783 (SPF);

Notes.—Frequently, *Diplazium longipes* has been identified as *D. celtidifolium* in Brazilian herbaria. These species are very similar but *D. celtidifolium* has monomorphic leaves, with lanceolate and linear scales on the veins abaxially, and winged spores with granulate surfaces (vs. subdimorphic leaves with linear scales and spores with smooth surfaces in *D. longipes*). The other congeneric species *D. roemerianum*, differs by symmetric pinnae, glabrous on both surfaces of the veins and conform or subconform apical pinna.

15. *Diplazium mattogrossense* A. Samp., Comm. Linh. Telegr. de Matto Grosso ao Amazonas Publ. 33: 18, t. 2. 1916. — TYPE: BRAZIL. Mato Grosso, *Smith s.n.* (lectotype, here designated R!, barcodes R000001344, R000001344a; isoelectotypes US!, barcode US00066981).

Diplazium grandifolium var. *andicola* Stolze, Fieldiana Bot. 27: 82. 1991.—*Diplazium andicola* (Stolze) M. Kessler and A. R. Sm., Brittonia 59 (2): 196. 2007. — TYPE: PERU. Loreto, Guamitanacocha, Rio Mazán, s.d., *J. Schunke* 281 (holotype: US!, barcode US 00048857, isotypes F, GH!, USM).

Figs. 2L, 3L, 7I–K.

Stem erect or decumbent, $1\text{--}1.5 \times 1.5\text{--}3$ cm, apex scaly; *leaves* ca. 100 cm long, arched; *petiole* $25\text{--}53 \times 0.2\text{--}0.3$ cm, with hairs simple and septate, scales lanceolate to deltate $2.5\text{--}4 \times 0.5\text{--}1$ mm, concolor, dark brown, base truncate or cordate, apices acute to acuminate, twisted, entire; *lamina* $20\text{--}54 \times 15\text{--}25$ cm, membranaceous, lanceolate, pinnate, base obtuse, apices acuminate, gradually tapering to a pinnatifid apex; *rachises* sulcate adaxially with a double wing $0.1\text{--}0.2$ mm, with hairs catenate $0.1\text{--}0.2$ mm, and scales linear $2\text{--}3.5 \times \text{ca. } 0.1$ mm adaxially and scarcely on abaxial side, without proliferous buds in the axils of distal pinnae; *pinnae* 8–13 pairs, $7.5\text{--}13 \times 2\text{--}3.5$ cm, oblong, base truncate or rounded, equilateral to slightly inequilateral, apices acuminate, crenate or serrate, apical pinnae pinnatifid, pinnae distal straight and oblique, petiolule to $1\text{--}2.5$ mm long; *veins* free, simple and 1–2 forked, pubescent, and with linear scales abaxially; *laminar tissue* glabrous on both surfaces; *sori* $5\text{--}15 \times 0.3\text{--}0.5$ mm, oblong, diplazioid and simple; *indusia* membranaceous, bicolorous, light brown, entire to irregularly erose; *spores* with perispore winged, not reticulate, surface smooth, folds echinulate.

Distribution and ecology.—*Diplazium mattogrossense* is distributed in Brazil from Rondônia to Paraná States and occurs in the west of the Atlantic Forest, and in the Amazon and Gallery. In South America it occurs in Peru, French Guiana, and Paraguay.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Acre: Sena Madureira, Igarapé Uirpurú, $9^{\circ}19'33''\text{S } 68^{\circ}20'69''\text{W}$, 7 Jul 2007, *Silveira et al.* 4105 (RB). Rondônia: Colorado do Oeste, Sítio Boa Esperança, Linha 1o eixo 4,5km rumo Colorado, 18 Jan 2007, *Neiva* 397 (RBR). Goiás: Formosa, Buraco das Andorinhas, 30 Aug 1998, *Ana Paula & Maria Emilia s.n.* (UB). Mato Grosso: Chapada dos Guimarães, Reserva Biológica do Colégio Evangélico de Buriti, Atmã, 8 May 1983, *Barcia* 1387 (R). São Paulo: Teodoro Sampaio, Parque Estadual Morro do Diabo, região do Pontal do Paranapanema, córrego, 7 de Sep, 26 Sep 1996, *Nonato* 270 (HB, SPF).

ADDITIONAL SPECIMENS EXAMINED.—GUIANA FRANCESA. Camp. no. 2, Roche Koutou, $2^{\circ} 52'\text{S } 54^{\circ} 03'\text{W}$, 19 Aug 1987, *J.J. Granville et al.* 9465 (B).

PERU. Loreto, between the roads ex Petroleros and Bello Horizonte, km 38–40 of the Road Iquitos Nauta, 9 Jan 1995, *Tuomisto et al.* 7202 (RB, TUR).

PARAGUAI. Vista Alegre, Jul 1921, *E. Rojas* 3840 (B).

Notes.—The number of pinnae and the longest petiolule can differentiate two species *Diplazium ottonis* Klotzsch with 19 pairs of pinnae, and *Diplazium mapiriense* Rosenst. with over 13 pairs of pinnae, petiolule in both is to $2.5\text{--}3$ mm long (vs. pinnae 8–13 pairs, petiolule to $1\text{--}2.5$ mm long in *D. mattogrossense*). *Diplazium urticifolium* Christ, has laciniate and fimbriate indusia, rachises and costae with a densely pubescent adaxial groove (vs. entire indusia and less pubescent rachises in *D. mattogrossense*).

16. *Diplazium mickelii* Mynssen & Sylvestre, Kew Bull. 64(3): 549. 2009. —
TYPE: BRAZIL. Espírito Santo: Castelo, Forno Grande, 15 Mai 1949, *Brade*

19821 (holotype RB, on three sheets, barcodes RB00591315, RB00591382, RB00591385).

Figs. 2M, 3B, 7L–N.

Leaves ca. 164 cm long; *petiole* ca. 68×0.8 –1 cm, with hairs septate, scales lanceolate to linear-lanceolate 1.5 – 2×0.2 – 0.3 cm, concolor, brown, base truncate or cordate, apices acuminate, twisted, entire; *lamina* 96 – 125×34 – 40 cm, chartaceous, lanceolate, pinnate, base truncated, apices acuminate, gradually tapering to a pinnatifid apex; *rachises* sulcate adaxially with a double wing 0.1 – 0.2 mm, with hairs septate 0.1 – 0.3 mm, and scales linear-lanceolate (0.5) 1 – 2.5 cm \times ca. 0.1 mm adaxially, without proliferous buds in the axils of distal pinnae; *pinnae* 20 – 22 pairs, 17 – 20×3 – 4.5 cm, entire, oblong to lanceolate, base truncate to cuneate, equilateral or inequilateral, apices acuminate, biserrate, apical pinnae pinnatifid, petiolule to 1 – 2 mm long; *veins* free, simple and 1 – 3 forked, pubescent, and with linear scales abaxially; *laminar tissue* with septate hairs on abaxial side, glabrous adaxially; *sori* 10 – 18×0.3 – 0.5 mm, oblong, diplazioid and simple, more than 25 pairs/pinna; *indusia* membranaceous, bicolorous, light brown, marginal cells lighter, entire; *spores* with perispore winged, reticulate, surface granulated, folds smooth.

Distribution and ecology.—*Diplazium mickelii* is considered to be an endemic and critically endangered Brazilian species (Mynssen and Sylvestre, 2009).

SELECTED SPECIMENS EXAMINED.—BRAZIL. Espírito Santo: Castelo, Forno Grande, 12 Oct 1948, *Brade 19235* (RB).

Note.—Although several research projects have been developed over the last eight years in the state of Espírito Santo, this species has never been collected again. It is known only from the type collection (Mynssen and Sylvestre, 2009).

Diplazium longipes has vein hairs similar to *D. mickelii*, but the laminar tissue is glabrous and the pinnae margin is entire (rarely crenated) or distally serrate (vs. laminar tissue with septate hairs on the abaxial side and a biserrate margin in *D. mickelii*).

17. *Diplazium moccennianum* (Sodiolo) C. Chr., Index Filicum 236. 1905. — *Asplenium moccennianum* Sodiolo, Recens. Crypt. Vasc. Quit. 37. 1883. — TYPE: ECUADOR. Pichincha, 400 m, *Sodiolo s.n.* (lectotype, designated by Arana, Mynssen, and Ponce, 2017: P!, barcode P00220174; probably isolectotype UC barcode UC678390; US! frag., barcode US00391222).

Figs. 2N, 4F.

Stem erect, ca. 6×1.5 cm, apex scaly; *leaves* ca. 150 cm long, fasciculate; *petiole* 46 – 60×0.8 – 1 cm, brown, with septate hairs, scales lanceolate 1.5 – 2×0.1 – 0.2 cm, straight, concolor, brown, base truncate, apices acuminate, entire; *lamina* 67 – 90×30 – 40 cm, chartaceous to coriaceous, lanceolate, pinnate-pinnatifid, base obtuse, apex acute-pinnatifid; *rachises* sulcate adaxially with a double wing ca. 0.2 mm, grooved with septate hairs ca. 0.1 mm, linear scales

3–10 × 0.1–0.2 mm, lanceolate scales 3–5 × 0.3–0.4 mm, similar to those of the petiole, without proliferous buds in the axils of distal pinnae; *pinnae* 9–16 pairs, 15–22 × 3.5–4.5 cm, lanceolate, base truncate, equilateral, apices acuminate, pinnae proximal incised 1/5 the distance to costae, apical pinnae pinnatifid, petiolule to 10–15 mm long; *veins* free, simple or forked, pinnate 5–7 branches, pubescent on adaxial groove costae, and with linear scales abaxially 0.5–2.5 × 0.1 mm; *laminar tissue* glabrous on both surfaces; *sori* 10–15 × 0.2–0.3 mm, oblong, diplazioid; *indusia* membranaceous, concolor, brown, 0.2–0.5 mm wide, entire to lobed; *spores* with perispore winged, not reticulate, surface rugulate, folds smooth.

Distribution and ecology.—The distribution of *Diplazium moccennianum* is known from Colombia, Ecuador, Bolivia, Brazil, and Argentina.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Pernambuco, Jaqueira, Usina Colônia, 3 Apr 2002, *Lopes and Pietrobon* 576 (SP, HUEFS, MBM). Minas Gerais: Caratinga, Estação Biológica de Caratinga, 25 Mar 2002, *Salino* 7963 (BHCB). São Paulo, Ubatuba, Parque Estadual da Serra do Mar, 10 Nov 1993, *Salino* 1862 (BHCB).

ADDITIONAL SPECIMENS EXAMINED.—ECUADOR. Oct 1908, *Sodi* (P01455182).

ARGENTINA. Misiones. Dpto. Iguazú: sendero Jacaratiá, 2 km del CIES, 4 December 1993, *Vanni et al* 3253 (CTES).

Notes.—*Diplazium moccennianum* is included in a complex of species pinnate-pinnatifid that can be distinguished by the margin incision towards the costae, and the pinnae base equilateral to inequilateral. For a long time, we had not considered it to occur in Brazil.

18. *Diplazium mutilum* Kunze ex Mart., *Flora* 22 Beibl. 1 (3): 37. 1839. — TYPE: BRAZIL. Bahia, *Luschnath s.n.–Martii Herb. Florae Brasil* 335 (lectotype BR, barcode BR0000006989545; isoelectotypes B!, barcode B 20 0048649, P!, barcodes P00571251, P02142010, P00541481, P00696339, P00696340, RB! barcode RB00543265; here designated).

Asplenium blanchetii Mett. ex Kuhn, *Linnaea* 36: 104. 1869. — *Diplazium blanchetii* (Mett. ex Kuhn) C. Chr., *Index Filic.* 228. 1905. — TYPE: BRAZIL. Bahia, *Blanchet* 2474 (lectotype, here designated: P!, barcode P01456221; isoelectotype P! barcodes P00570920, P00571247; BM!, barcode BM000785602, NY! barcode NY579358).

Figs. 2O, 3F, 8A–B.

Stem erect or decumbent, 25 × 1–1.5 cm, apex scaly; *leaves* ca. 160 cm long, fasciculate; *petiole* 53–74 × 0.5–1 cm, brown, with hairs septate, with linear scales 0.6–1.2 × ca. 0.1 mm and lanceolate 0.8–1.5 × 0.1–0.3 cm, base rounded, apices acute to acuminate, entire to dentate; *lamina* 54–70 × 28–40 cm, membranaceous, pinnate-pinnatifid, base obtuse, apex acuminate-pinnatifid; *rachises* sulcate adaxially with a double wing 0.2–0.4 mm, with hairs catenate 0.2–0.4 mm, and scales linear 0.5–4 × 0.1 mm on both surfaces, without

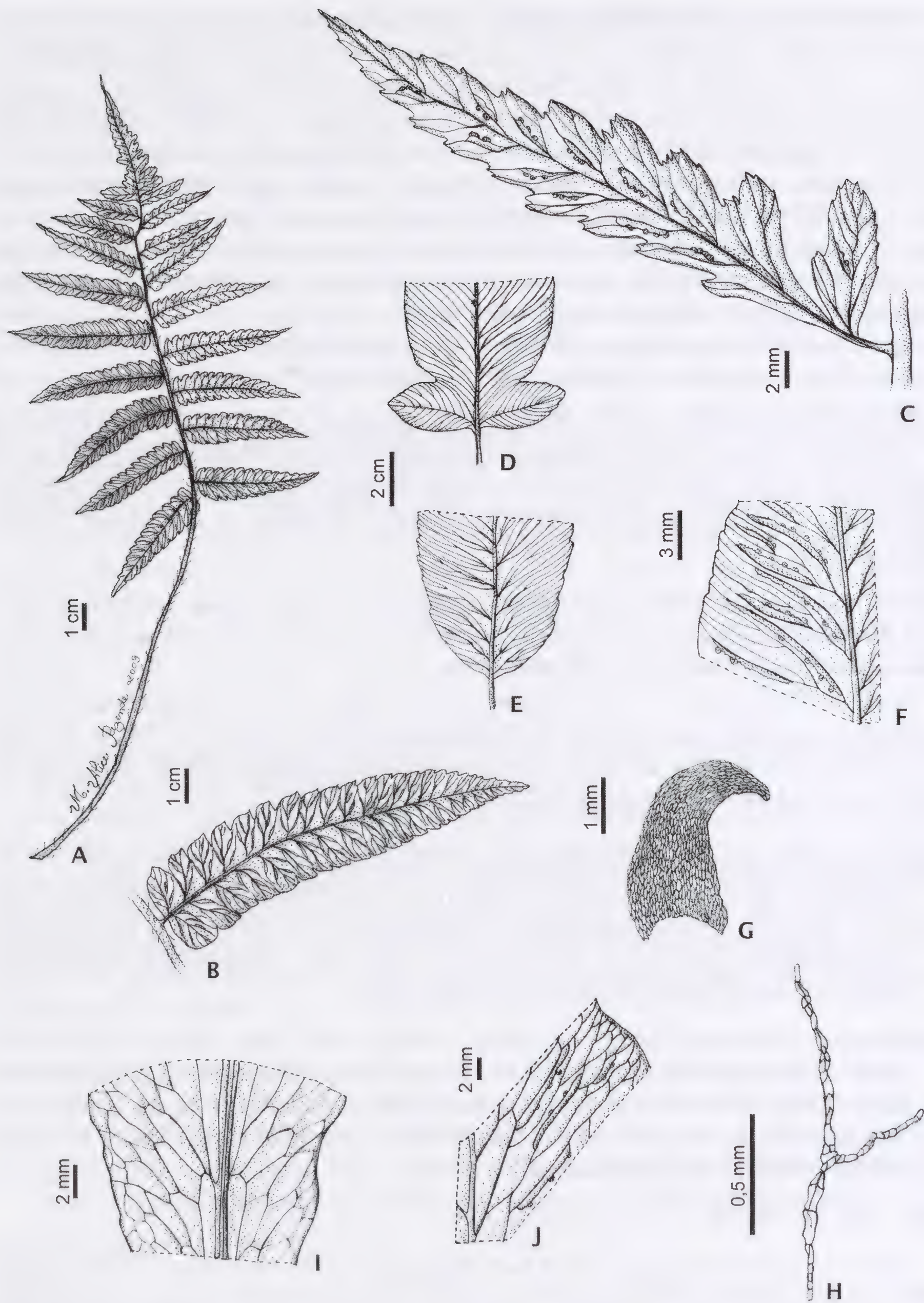


FIG. 8. A–B. *Diplazium mutilum* A. leaf, B. detail of pinnae (Mynssen et al. 954); C. *D. petiolulatum*, proximal pinnae (Neiva 425); D–H. *D. plantaginifolium*, D–E. detail of lamina base (Duarte 3443), F. oblong sori (Cislinski 231), G. petiole scales, H. lamina hairs (F.B. Matos 1385); I–J. *D. praestans*, I. detail of lamina base, J. Detail of lamina with sori (G. Prance et al. 7400).

proliferous buds in the axils of distal pinnae; *pinnae* 10–19 pairs, 11–15 \times 1.7–2 cm, lanceolate to oblong, base truncate or rounded, equilateral, apices acute to acuminate, proximal and distal pinnae incised ca. 1/3 the distance to costae, apical pinnae pinnatifid, petiolule to 1.5–6 cm long; *veins* free, simple and 1–2 forked, pubescent, and with linear scales abaxially 1–1.5 \times ca. 0.1 mm; *laminar tissue* glabrous on both surfaces; *sori* 5–10 \times 0.3–0.5 mm, oblong, diplazioid, more than 25 pairs/ pinna; *indusia* membranaceous, bicolorous, light brown, 0.2–0.5 mm wide, entire to irregularly laciniate; *spores* with perispore low folded, cristate, not reticulate, surface and folds rugulate.

Distribution and ecology.—We consider *Diplazium mutilum* to be endemic to Brazil, occurring from Alagoas to Santa Catarina States in humid forests.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Alagoas: Ibateguara, Usina Serra Grande, Engenho Coimbra, Grotta do Taquari/ Porcos, 10 Feb 2001, *Pietrobon and Santiago* 4928 (CEPEC, UB, UFP). Bahia: Jussari, Serra do Teimoso RPPN, 12 Dec 2005, *Mynssen* 949, 952, 954 (RB). Minas Gerais: Descoberto, Reserva Biológica do Grama, 15 Jun 2005, *Mynssen* 739 (RB). Espírito Santo: Santa Maria de Jetibá, Jatiboca, 1946, *Brade* 3341 (CESJ). Rio de Janeiro: s.d., *Diogo Velho* (P00571250). São Paulo: Cajuru, próximo a curso d'água, barranco, Fazenda Santa Carlota, 16 Dec 1999, *Nicolau et al.* 2111 (CEPEC, K, RB). Paraná: Jundiaí do Sul, Mata do Ibiti, 7 Mar 2003, *Carneiro* 1430 (MBM). Santa Catarina: Blumenau, 5 Jul 1952, *Reitz* 4066 (HBR, PACA).

Notes.—*Diplazium blanchetii* (Mett. ex Kuhn) C. Chr. is considered to be a synonym of *D. mutilum*, based on the pinnae morphology, and irregularly laciniate indusia. Furthermore, the types are from the same locality. The type collections were distributed to several herbaria and *Luschnath* corresponds to specimen number *Martii* 335 as indicated on the “*Florae Brasiliensis*” (Baker, 1870). This collection was also incorporated into the Moricand herbarium by a Swiss botanist, as pointed out in “*Herbarium Florae Brasiliensis–Plantae brasilienses exsiccatae*” (Martius, 1837).

There are congeners that present similar lamina or pinnae architecture, such as *Diplazium centripetale* (Baker) Maxon from the Antilles, however, while the rachis and petiole are densely scaled, the basal pinnae are reduced and deflexed; *Diplazium cuneifolium* Rosenst. from Bolivia, has narrow pinnae, cuneate basally (vs. a truncate or rounded pinnae in *D. mutilum*), a longer petiolule and with hairs on the abaxial costae.

19. *Diplazium petiolulatum* (Stolze) A. R. Sm., *Brittonia* 59 (2): 197. 2007. — *Diplazium bombonasae* Rosenst. var. *petiolulatum* Stolze, *Fl. Ecuador* 49: 53. 1994. — TYPE: ECUADOR. Prov. Sucumbíos, Rio Wai Si Ayá, N tributary of Rio Aguarico, along path 6 km from San Pablo, 300m, *Brandbyge and Azanza* 32732 (holotype UC, isotype QCA).

Figs. 2P, 3K, 8C.

Stem erect, ca. 2.5 \times 0.2 cm, apex scaly; *leaves* 18–44 cm long, arched, fasciculate; *petiole* 9–12 \times 0.15–0.2 cm, light brown, glabrous, scales lanceolate

2.5–4 × 0.3–0.4 mm, straight, concolor, dark brown, base truncate, apices acute, entire; *lamina* 17–21 × 5–6.5 cm, membranaceous, pinnate-pinnatifid, lanceolate, apex acuminate-pinnatifid; *rachises* sulcate adaxially with a double wing ca. 1 mm, glabrous on both faces, scales filiform 0.3–0.6 × 0.1 mm, without proliferous buds in the axils of distal pinnae; *pinnae* 12–15 pairs, lanceolate, base cuneate, inequilateral, apices acuminate, crenate, apical pinnae pinnatifid, proximal pinnae auriculate, 2–3 pairs proximal pinnae with lobes free on the acroscopic side, petiolule to 0.5–2 mm long; *veins* free, simple and 2–3 forked, 12–15 pairs from costae; *laminar tissue* glabrous on both surfaces; *sori* 5–10 × 0.3–0.5 mm, arcuate, elliptic, 7–9 pairs/ pinna, simple rarely diplazioid; *indusia* membranaceous, bicolorous, entire, and brown with a set of cells cleared marginally; *spores* with perispore cristate, reticulate, surface and folds rugulate slightly echinulate.

Distribution and ecology.—*Diplazium petiolulatum* occurs along the eastern base of the Andes from Ecuador to Bolivia between 200 and 1600 m (Kessler and Smith, 2007). In Brazil this species is distributed only in Rondônia State.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Rondônia: Colorado do Oeste, Linha 175 km 20, propriedade Sr. José Manuel dos Anjos, 2 Feb 1997, *Neiva 425* (NX, RBR). São Paulo: São Paulo, Parque Estadual de Jacupiranga, Núcleo Caverna do Diabo, trilha do Araça e trilha do rolado, 21 May 2006, *Salino et al. 11112* (RB, BHCB).

ADDITIONAL SPECIMENS EXAMINED.—ECUADOR. Sucumbíos, Rio Wai Si Ayá, N tributary of Rio Aguarico, along path 6 km from San Pablo, *Brandbyge and Azanza 32732* (RB, TUR).

PERU. Madre de Dios, Manu, Southern side of Rio Manu, close to Cocha Cashu Biological Station, 11 Oct 1998, *Tuomisto et al. 13193* (RB, TUR).

Notes.—The proximal pinnae are stalked with an acroscopic lobe cut fully in *Diplazium petiolulatum*, which differs from *Diplazium bombonasae* (Kessler and Smith, 2007).

20. *Diplazium plantaginifolium* (L.) Urb., Symb. Antill. 4: 31. 1903. — *Asplenium plantaginifolium* L., Syst. Nat. Ed. 10. 2: 1323. 1759. — *Asplenium plantagineum* L. Sp. PL. 2. 2: 1537. 1763, *nom. superf.* (neotype designated by Proctor, 1985: US!).

Diplazium acuminatum Raddi, Pl. bras. Nov. gen. 1: 41, t. 57, f. 2. 1825. — TYPE: BRAZIL. Rio de Janeiro, Rio de Janeiro, Corcovado, *Raddi s.n.* (lectotype, designated by Pichi-Sermolli, 2005: PI; probably isolectotype FI). *Nom. nov.* to *Diplazium repens* Raddi, Syn. fil. bras. 3: 292. 1819.

Diplazium plantaginifolium var. *serratum* Fée, Crypt. vasc. Brésil 1: 75. 1869. — TYPE: BRAZIL. Rio de Janeiro, *Glaziou 2347* (lectotype, here designated: P!, barcode P00639536, P01625977; isolectotype RB! barcode RB00748598, K!).

Figs. 1A, 1P, 2Q, 4E, 8D–H.

Stem erect or decumbent, $2-9 \times 0.5-1$ cm, apex scaly; *leaves* 24–58 cm long erect to arched, fasciculate; *petioles* $7-39 \times 0.1-0.2$ cm, light brown, glabrous, with scales deltate $0.5-2 \times 0.5-1$ mm, concolor, blackish-brown, base truncate, apices acute, entire; *lamina* $13-28 \times 3-7$ cm, chartaceous, entire, lanceolate to oblong-lanceolate, apices acuminate, base obtuse, lobate or cuneate, asymmetric or symmetric, entire to serrate; occasionally with a bud at blade bases; adaxial midrib groove glabrescent, abaxially with hairs septate or branched, blackish-brown; *veins* free, simple to 2–4-forked; *laminar tissue* glabrous on both surfaces; *sori* $0.5-1 \times 0.5$ mm, oblong, diplazioid, persistent; *indusia* concolor, brown, entire; *spores* with perispore cristate, not reticulate, folds and surface rugulate echinulate.

Distribution and ecology.—*Diplazium plantaginifolium* has a wide distribution and occurs from Mexico, Central America, and the Antilles to South America. In Brazil, it is known in shady places and low montane forests.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Pernambuco: Igarapeba, Eng. Brejinho, 16 Jun 1972, *I. Pontual* 1198 (PACA). Alagoas: Colônia Leopoldina, 1836, *Blanchet* 2459 (BM); Ibateguara, Usina Serra Grande, Serra do Coimbra, Grota do Dudé, 9 Feb 2001, *Pietrobon* 4834 (CEPEC, SP). Bahia: Almandina, Serra Corcovado, 21 Jun 2005, *Fiaschi and Paixão* 2945 (CEPEC). Minas Gerais: Carangola, 27 Dec 1987, *Leoni* 78 (CEPEC). Espírito Santo: Linhares, Rio Doce Tres Ilhas, 20 Apr 1934, *Kuhlmann* 3340 (CESJ). Rio de Janeiro: Rio de Janeiro, Parque Nacional da Tijuca, 9 Aug 1977, *Carauta* 2503 (RB). São Paulo: Serra da Cantareira, 31 Jul 1939, *Pickel* 4400 (SP). Paraná: Antonina, Morro do Pilão, 4 Feb 1982, *Hatschbach* 44540 (MBM). Santa Catarina: Blumenau, 5 Jul 1951, *Reitz* 4068 (HBR, BM). Rio Grande do Sul: Morrinhos do Sul, *Windisch and Oliveira* 9587 (PACA, RBR).

ADDITIONAL SPECIMENS EXAMINED.—MEXICO. s.d., *Schaffner* 48 a (RB).

NICARÁGUA. 26 Feb 2006, *Testo* 1046 (VT, RB).

GUADALOUPE. s.d., *L'Hermnier* 1861 (RB); Basse Terre, Prise d'Eau, near Morne Goyavier, 10 Mar 2005, *Christenhusz* 4019 (RB, TUR).

FRENCH GUIANA. s.d., *Poiteau* s.n. (RB).

PARAGUAY. Canindeyu, s.d., *B. Jimenéz and G. Marín* 0116 BJ (RBR)

Notes.—There are few American species of *Diplazium* with entire blades (Stolze, Pacheco, and Øllgaard, 1994). The anastomosing veins and blade and petiole hairs can be used to distinguish from the Brazilian species with entire blades (e.g., *Diplazium aberrans* and *D. praestans*).

Fée (1869) described the variety *Diplazium plantaginifolium* var. *serratum*, distinguished from the typical variety by the blade with an acuminate apex, wide base, and serrated margin. However, these characteristics are not consistent enough to justify the infraspecific category because they can be found in a single specimen.

21. *Diplazium praestans* (Copel.) C. V. Morton, Contr. U. S. Natl. Herb. 38: 41. 1967. — *Athyrium praestans* Copel., Amer. Fern J. 38: 132. 1948. — TYPE: PERU. San Martin, Chazuta, Rio Huallaga, *Klug* 4002 (holotype US!,

barcode 00810671; isotypes CAS, barcode CAS0001050, F, barcode F0075630F, GH, barcode GH00021001, K!, barcode K000632800, MO MO-255762, NY!, barcode NY00149348, S! accession S-R-1639; UC barcode UC709855).

Figs. 3A, 8I–J.

Stem erect, $2\text{--}4 \times 0.4\text{--}1.2$ cm, apex scaly; *leaves* erect to 20×34 cm long, fasciculate; *petioles* $3\text{--}5 \times 0.3\text{--}0.5$ cm, brown, scales linear to lanceolate, $1\text{--}2 \times 0.3\text{--}0.5$ mm, concolor, blackish-brown, base truncate, apices acuminate, entire; *lamina* $20\text{--}33 \times 5\text{--}8$ cm, membranaceous to chartaceous, entire, ovate to oblanceolate, base cuneate asymmetric decurrent, the apex obtuse, entire margins; *costae* slightly grooved in the proximal portion adaxially on proximal with septate ca. 0.1 mm; *veins* anastomosing, indument adaxially restricted to costal grooves; *laminar tissue* glabrous on both surfaces; *sori* $0.5\text{--}2 \times 0.5\text{--}1$ mm, oblong, diplazioid and simple; *indusia* membranaceous, concolor, pale brown, entire; *spores* ellipsoidal, monolete.

Distribution and ecology.—*Diplazium praestans* is distributed in Peru, Bolivia, and Brazil where it occurs only in the Amazon basin.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Acre: Tarauacá, rio Muru, 19 Sep 1968, G. Prance *et al.* 7400 (INPA, K, NY, R); Jordão, Rio Jordão, 6 Feb 2009, Goldenberg *et al.* 1325 (NY, RB, UPCB)

PERU. San Martin, Chazuta, rio Huallaga, Mar 1935, Klung 4002 (US).

Notes.—*Diplazium aberrans* is frequently confused with *D. praestans*, but can be distinguished by the hairs and the size of the blade. *Diplazium praestans* has a glabrous blade, and petiole scales with entire margins.

22. *Diplazium riedelianum* (Bong. ex Kuhn) C. Chr., Index Filic. 230. 1905. — *Asplenium riedelianum* Bong. ex Kuhn, Linnaea 36: 102. 1869. — TYPE: BRAZIL. Riedel *s.n.* (lectotype B! barcode B 20 0049408; isolectotypes K! barcode K000632763, NY! barcode NY00149394 fragment and drawing; designated by Adams, *Flora Mesoamericana* 1: 241. 1995)

Diplazium dissimile Fée, Crypt. vasc. Brésil 1: 76, t. 21, f. 1. 1869. — TYPE: BRAZIL. Santa Catarina, Mors 16 (lectotype, designated by Testo, Sundue, and Vasco, 2017: P!, barcode P00696338; isolectotype RB!, RB00543260).

Figs. 3I, 9A–B.

Stem erect, $1.5\text{--}7 \times 0.3\text{--}1$ cm, apex scaly; *leaves* 22–52 cm long, arched, fasciculate; *petioles* $12\text{--}24 \times 0.1\text{--}0.5$ cm, light brown, glabrous distally, scales deltate to lanceolate, ca. $5 \times 1\text{--}2$ mm, concolor, blackish-brown, base truncate, apices acute or acuminate, entire; *lamina* $15\text{--}32 \times 3\text{--}10$ cm, pinnate 1/4 proximally, pinnatifid 3/4 distally, chartaceous, lanceolate to oblong-lanceolate, base obtuse, apices acuminate; *rachises* with septate hairs abaxially 1–2 mm long, brown, glabrous adaxially; *pinnae* 1–5 free pairs proximally, lanceolate, base truncate or round, equilateral, apices acute to acuminate, margin entire to crenate, sessile or petiolulate, petiolule $2\text{--}10 \times 1\text{--}$



FIG. 9. A–B. *Diplazium riedelianum*, habit (Mors 16), B. detail showing the buds (Luederwaldt s.n. SP-691); C–E. *D. roemerianum*, C. detail of pinnae, D–E. hairs of lamina (Mynssen et al. 955); F–G. *D. rostratum*, F. detail of pinnae, H. detail of pinnule showing the veins and sori (Mynssen et al. 961); H–K. *D. tamandarei*, H. detail of pinnule showing the veins and sori, I. petiole scale, J–K. hairs of rachis (Brade 6529); L–N. *D. turgidum*, L. pinnule, M. detail of the segment showing the sori and indusia with fimbriae, N. scale of lamina (R 109507).

1.5 mm; buds present or not on the axil of the pinnae proximally, with scales similar to those of the petiole; *veins* free, simple to 1–3-forked, 9–15 pairs/pinna; *laminar tissue* glabrous on both surfaces; *sori* 3–10 × 1–2 mm oblong, falcate, diplazioid and simple, 5–20 pairs/segment; *indusia* membranaceous, concolor, brown, entire; *spores* with perispore cristate, not reticulate, folds and surface granulated.

Distribution and ecology.—*Diplazium riedelianum* occurs in Brazil (south/southeast) and Paraguay, growing in humid lowland forests.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Minas Gerais: Fazenda Santa Anna, s.d., s. col. (R 206184). Espírito Santo: Linhares, Reserva de Goytacazes, 20 Oct 2000, *Folli 3719* (BHCB). Paraná: Antonina, Reserva Natural do Rio Cachoeira, 25° 15' S 48° 41' W, 200 m, 12 Sep 2008, *Matos et al. 1600* (UPCB). Santa Catarina: Araranguá, 10 Mar 1942, *Reitz 226* (RB).

ADDITIONAL SPECIMENS EXAMINED.—PARAGUAY. Canendiyú, Mbaracayú, 12 June 1998, *Zardini 48839* (RB).

Notes.—Mickel and Smith (2004) recognized *D. vera-pax* (Donn. Sm.) Hieron. as a distinct species by the sori on the acroscopic side of the veins (vs. sori on both sides of the vein in *D. riedelianum*). Testo, Sundue, and Vasco (2017) highlighted the hybrid origin of these two species and, although their parentages are uncertain, one of their parents probably belongs to the *D. cristatum* complex.

23. *Diplazium roemerianum* (Kunze) C. Presl, Tent. Pterid. 113. 1836. — *Asplenium roemerianum* Kunze, Linnaea 9: 62. 1834. — *Athyrium roemerianum* (Kunze) Milde, Bot. Zeit. (Berlin) 28: 354. 1870. — TYPE: PERU. Huánuco, Pampayacu, Jul. 1829, *Poeppig 166* (lectotype, designated by Stolze, Pacheco, and Øllgaard, 1994: B!, barcode B 20 0049424; isoelectotypes B! barcodes B 20 0049420, B 20 0049423; P! barcode P00220167; K; L).

Figs. 1L, 1O, 2R, 3J, 9C–E.

Stem erect or decumbent, 6–12 × 1–1.4 cm, apex scaly; *leaves* 100 cm long, arched, fasciculate; *petiole* 36–42 × 0.4–0.7 cm, brown proximally, with hairs septate scarcely, with lanceolate scales 10–20 × 1–2 mm, concolor, brown, base truncate or rounded, apices acuminate, entire to dentate; *lamina* 56–61 × 34 cm, membranaceous, lanceolate, pinnate, base obtuse, apices acute; *rachises* sulcate adaxially with a double wing 0.1–0.2 mm, groove with hairs catenate ca. 0.2 mm, glabrescent abaxially, without buds on the axil of the pinnae; *pinnae* 4–11 pairs, 16–20 × 2.5–5 cm, lanceolate, base cuneate, equilateral, apices acuminate, entire to crenate, apical pinnae conform or subconform with 1–2 lobes, petiolule to 2–5 mm long; *veins* free, simple and 1–2 forked, arcuate, hydathodes absent, pubescent abaxially; *laminar tissue* glabrous on both surfaces; *sori* 0.3–16 × 0.5–1 mm, oblong, slightly arcuate, diplazioid and simple, more than 25 pairs/pinna; *indusia* membranaceous, bicolorous, light

brown, entire; spores with perispore winged, reticulate, surface and folds echinulate granulated.

Distribution and ecology.—*Diplazium roemerianum* has a very restricted distribution in the Brazilian forest known as “Hiléia Baiana” and Rio Doce Atlantic forest, at Bahia and Minas Gerais states. This species is widely distributed in Central America, Venezuela, Colombia, Peru, Ecuador, and the Antilles.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Bahia: Jussari, RPPN Serra do Teimoso, 12 Dec 2005, *Mynssen et al.* 955 (RB). Minas Gerais: Rio Doce, 14 Jul 1933, *Badini* 188 (OUPR).

ADDITIONAL SPECIMENS EXAMINED.—ECUADOR. Província Napo, rio Agurrico, Santa Cecília, Muñoz, 00°04'N 076°58'W, 24-25 Nov 1966, *Sparre* 1314 (NY); Napo, Yasni Nacional Park, km 118.2 along the oil road, 17 Mar 1998, *Tuomisto and Ruokolainen* 11786 (TUR).

COLOMBIA. Nova Granada, Ocanã, Jan, 4 abril 1951, *Bell* 241, 526 (RB).

PERU. Distrito El Cenepa, Comunidade Mamayaque, Cabecera de La quebrada Saasá, 04° 37'03"S 78° 19'57"W, 560 m, 13 Aug 1997, *Vasquez and Quiaco* 24545 (NY).

Notes.—*Diplazium sanctae-rosae* Christ, from Costa Rica numerous pinnae (ca. 12 pairs), and at least four pairs of the apical pinna reduced (vs. 4–11 pairs of pinnae, and only one pair of slightly reduced distal pinnae in *D. roemerianum*). *Diplazium grandifolium* (Sw.) Sw. resembles *D. roemerianum* according to Stolze, Pacheco, and Øllgaard (1994) but the lamina has a pinnatifid apex and the veins are 3–5 forked, (vs. apical pinnae conform or subconform, 1–2 forked veins in *D. roemerianum*). There are six infraspecific taxa associated with *Diplazium roemerianum* beyond the typical form. Three of them were described from Ecuador: *D. roemerianum* var. *rufescens* Stolze, with a dark reddish-brown rachis, and buds in distal pinna axils; *D. roemerianum* var. *brevifolia* Rosenst. acuminate and serrate pinnae, apical pinnae pinnatifid, and veins ending with hydathodes; and *D. roemerianum* var. *mindesis* Hieron. has caudate and serrate apical pinnae. Three taxa were described from Colombia: *Diplazium roemerianum* var. *caucense* (H. Karst.) Hieron. with crenate to serrate pinnae, auriculate apical pinnae and a narrow indusium; *D. roemerianum* var. *crassidens* (Fée) Hieron. with conform apical pinnae, 4–5 pairs of pinnae and only one pair reduced at the apex; and *D. roemerianum* var. *ocanniense* (Karst.) Hieron. has reduced pinnae to the apex, and bi-auriculate apical pinnae. This group needs to be further studied in order to recognize the morphological limits of the described taxa. For this reason, we prefer not to adopt infraspecific categories.

24. *Diplazium rostratum* Fée, Crypt. vasc. Brésil 1: 81, t. 24, f. 2. 1869. — TYPE: BRAZIL. Rio de Janeiro, *Glaziou* 2331 (lectotype, here designated: P!, barcode P01630049; isoelectotype K! barcode K000632766; S!, accession 05-10589).

Diplazium remotum Fée, Crypt. vasc. Brésil 1: 81, t. 24, f. 1. 1869. — TYPE: BRAZIL. Rio de Janeiro, *Glaziou* 2332 (lectotype, here designated: P! barcode P00541509; isoelectotype P! barcodes P01630040, B! barcode B 20 0049401).

Figs. 1E–F, 1I, 3J, 9F–G.

Stem erect, 20–40 × 6–12 cm, apex scaly; *leaves* 130–350 cm long, arched, fasciculate; *petioles* 67–150 × 0.7–1.5 cm, brown, with septate hairs ca. 0.1 mm, scales lanceolate 7–18 × 0.2–2.5 mm, concolor, dark brown, base cordate or rounded, apices acuminate, entire to bifid toothed; *lamina* 1–1.8 × 0.8–1.2 m, chartaceous, 2-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, tomentose on both surfaces, with lanceolate scales 7–20 × 0.2–1 mm, dentate with teeth bifid, bicolor; *pinnae* 30–67 × 9–23 cm, petiolule to 8–20 mm long, with 10–18 pairs; *pinnules* 12–16 pairs, 5–13 × 2–4.5 cm, lanceolate, bases truncate, inequilateral, with apices obtuse to acuminate, entire to crenate; *veins* free, pinnate, simple or 1–2 forked, costae grooved adaxially, with wings 0.2–0.3 mm; *laminar tissue* glabrous on both surfaces; *sori* 2–5 × 0.2–0.4 mm, oblong, diplazioid and simple; *indusia* persistent, membranaceous, brown, flat, laciniate; *spores* with perispore winged, not reticulate, surface rugulate granulated, folds echinulate wings.

Distribution and ecology.—*Diplazium rostratum* occurs in the south and southeast of the Brazilian Atlantic Forest. It is also distributed in Venezuela, Peru, and Ecuador.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Minas Gerais: Caparaó, Parque Nacional do Caparaó, 20 Nov 1988, *Brügger* 503 (CESJ). Rio de Janeiro: Itatiaia, Parque Nacional de Itatiaia, 16 Jul 1939, *Brade* s.n. (RB 410318). São Paulo: Bananal, Estação Ecológica do Bananal, 1200–1450m, 11 Sep 2001, *Salino* 7488 (BHCB). Paraná: Morretes, Estrada da Graciosa, 14 Feb 1993, *Cislinski* 257 (UPCB); Santa Catarina: Bom Retino, Riosinho, 24 Dec 1948, *R.Reitz* 2790 (RB). Rio Grande do Sul: Sapiranga, Picada Verão, 18 Jun 1989, *Amaury Jr* s.n. (PACA 88315).

Notes.—Fée (1869) described two species in the same work: *D. remotum* and *D. rostratum*, both from the Serra dos Órgãos National Park, Rio de Janeiro, Brazil. We consider these two species as synonyms, following the concept of Cislinski (1996). The laminar architecture is insufficient to segregate them. Furthermore, *D. remotum* was applied in several works (e.g., Tryon and Stolze, 1991; Stolze, Pacheco, and Øllgaard, 1994). In order to choose a legitimate name from names with the same priority, the first author to make the choice with the respective synonym should be followed, according to the International Code of Botanical Nomenclature.

25. *Diplazium striatastrum* Lellinger, Selbyana 2(2–3): 283, tpl 1B. 1978. — TYPE: COSTA RICA. Cartago: Tuis, near Turrialba, alt. 620 m, Pittier 11248

(holotype US! barcode 00066955, isotypes BM, K! K000632713, K000632714, MO, P! barcodes P00541471, P00696326).

Figs. 4F.

Stem erect, ca. 6×1 cm, apex scaly; *leaves* 80–100 cm long, arcuate, fasciculate; *petiole* $37\text{--}45 \times$ ca. 0.5 cm, brown, with septate hairs 0.2–0.4 mm, scales linear ca. 1 mm, and lanceolate $0.7\text{--}1 \times 0.2\text{--}0.3$ cm, concolor, brown, straight or twisted, base truncate, apices acuminate, entire; *lamina* $55\text{--}60 \times 25\text{--}30$ cm, lanceolate, pinnate-pinnatifid, apex acute-pinnatifid, base obtuse, chartaceous, without proliferous buds on the axils of distal pinna; *rachises* grooved adaxially with a double wing ca. 0.3 mm, with septate hairs on both surfaces, with linear scales like those of the petiole on abaxial sides, without proliferous buds in the axils of distal pinnae; *pinnae* 14–17 pairs, $20\text{--}24 \times 3.8\text{--}4.5$ cm, oblong to lanceolate, base truncate, equilateral, apices acuminate, entire or crenate, incised $2/3$ or more the distance to costae, apical pinnae pinnatifid, petiolule to 3–8 mm long; *veins* free, simple and 2 forked, pubescent on adaxial groove costae, and with linear scales abaxially ca. 0.5 mm; *laminar tissue* pubescent abaxially, and glabrous on adaxial surface; *sori* $3\text{--}5 \times 0.2\text{--}0.3$ mm, oblong, diplazioid, more than 30 pinna pairs; *indusia* membranaceous, concolor, brown, entire to lobed; *spores* with perispore winged, reticulate, surface and folds echinulate granulated.

Distribution and ecology.—*Diplazium striatastrum* is distributed from Mexico to South America. In Brazil is an infrequent species at the Atlantic Forest.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Paraná: Telêmaco Borba, 26 Dec 2011, *Michelon 1225* (MBM).

ADDITIONAL SPECIMENS EXAMINED.—COSTA RICA. Puntarenas: San Vito, 12 Jan 2017, *Testo & Mynssen 1263* (VT, RB).

ECUADOR. Pichincha: Santo Domingo de los Colorados, 31 Mar 1967, *Sparre 15204* (S, RB).

Notes.—This species belongs to a group distinguished by a combination of the following characters: pinnate-pinnatifid lamina, a deep (or not) incision of the pinnae and by the pubescence of the laminar tissue and axis. As highlighted by Mickel and Beitel (1988), more studies are needed to determine the relationship between *D. striatastrum* and *D. striatum* (L.) C. Presl, which can be distinguished, among other characters, by the basal pinnae being completely pinnate in *Diplazium striatum* (vs. basal pinnae incised to $1/3$ towards the costae in *D. striatastrum*).

26. *Diplazium tabalosense* Hieron., Hedwigia 47: 214, pl. 1. 1908. — TYPE: PERU. San Martin, above Tabalososs on the way to Moyobamba, Huallaga River valley, *Stübel 1089* (lectotype, designated by Tryon and Stolze, 1991: B!, barcode B 20 0049840).

Figs. 2S, 4F.

Stem erect, ca. 15×1.5 cm, apex scaly; *leaves* ca. 150 cm long, erect arcuate, fasciculate; *petiole* ca. $30 \times$ ca. 0.8 cm, brown, with septate hairs, scales linear 0.4–0.7 cm, and lanceolate ca. 1×0.5 cm, concolor, dark brown, straight, base truncate, apices acuminate, entire; *lamina* 72–120 \times 40–48 cm, membranaceous, lanceolate, pinnate-pinnatifid, base obtuse, acute, gradually tapering to a pinnatifid apex; *rachises* sulcate adaxially with a double wing 0.3 mm, groove on adaxial side with hairs septate ca. 0.1 mm, linear scales 1–1.2 \times 0.1 mm, lanceolate scales ca. 2×0.5 mm, base truncate or cordate, apices acute, entire, without proliferous buds in the axils of distal pinnae; *pinnae* ca. 12 pairs, 15–18 \times 3.5–4 cm, oblong to lanceolate, base truncate, equilateral, apices acute or acuminate, proximal and distal pinnae incised 2/3 or more the distance to costae, apical pinnae pinnatifid, petiolule to 3–8 mm long; *veins* free, simple and 2-3 forked, pubescent on adaxial groove costae, and with linear scales abaxially; *laminar tissue* glabrous on both surfaces; *sori* 3–5 \times 0.8–1.2 mm, oblong, diplazioid, 6–8 pairs/segment; *indusia* membranaceous, concolor, brown, with 0.2–0.5 mm wide, lobed to laciniate; *spores* with perispore winged, reticulate, surface rugulate granulated, folds echinulate.

Distribution and ecology.—*Diplazium tabalosense* occurs in Venezuela, Peru, and Bolivia, where it is considered to be rare (Kessler and Smith, 2017).

SELECTED SPECIMENS EXAMINED.—BRAZIL. Pernambuco: São Vicente Férrer, Complexo Serra do Mascarenhas, 12 Sep 199, *Pietrobon* 4612 (SP). Minas Gerais: Inhapim, Margens do Rio Munhaçu, 30 May 2009, *Almeida et al.* 1980 (BHCB, RB). Rio de Janeiro: Cachoeiras de Macacu, Proximo as margens do rio São João, 16 Nov 1977, *Carauta et al.* 2306 (GUA, PACA, RB). São Paulo: Paranapiacaba, Estação Biológica, *Handro* 1233 (SPF). Paraná: Paranaguá, Pico Torto - encosta oriental, 2 Feb 1970, *Hatschbach* 22872 (PACA).

Notes.—*Diplazium tabalosense* is a species from Bolivia and it is now recognized in Brazil.

27. *Diplazium tamandarei* Rosenst., *Hedwigia* 56: 364. 1915. – TYPE: BRAZIL. São Paulo, Serra Cantareira, *Brade et Tamandaré* 6529 (lectotype, here designated B!, B 20 0049848; isolectotypes B! barcodes B 20 0049849, B 20 0049880, HB!, MVM photo!, NY! barcode NY00149402, RB! barcodes RB00591311, RB00591383, S! accession S-R-1642, S05-10633; UC 441779).

Figs. 1H, 2T, 9H–K.

Stem erect, ca. 50 cm, apex scaly; *leaves* ca. 150 cm long, arched, fasciculate; *petioles* ca. 1.5 cm wide, dark brown, with septate hairs ca. 0.6 mm, scales linear ca. 1.5×0.1 mm, and scales lanceolate ca. $8\text{--}15 \times 0.5\text{--}1$ mm, concolor, brown, base truncate, apices acuminate, twisted, entire to dentate; *lamina* membranaceous, 3-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, with hairs septate, tomentose on both surfaces, with linear scales $0.6\text{--}1.2 \times$ ca. 0.1 mm abaxially; wings membranaceous 0.2–0.5 mm wide; *pinnae* 25–40 \times ca. 15, petiolule to 10–25 mm long; *pinnules* 9–15 \times 2–3 cm, 10–15 pairs, lanceolate, base rounded,

equilateral, with apices acuminate pinnatifid; *pinnules* 3rd order $15\text{--}20 \times 3\text{--}4$ mm, 10–12 pairs, pinnatissect, elliptic to oblong, margins crenate; *veins* free, pinnate, simple to 1–2 forked, 6–9 pairs, costae grooved adaxially, with wings 0.1 mm, pubescent on both surface; *laminar tissue* tomentose on both surface; *sori* $0.5\text{--}2 \times 0.2\text{--}0.4$ mm, oblong, diplazioid and simple, 5–8 per segment; *indusia* persistent, membranaceous, brown, entire to fimbriate; *spores* with perispore cristate, not reticulate, folds and surface smooth.

Distribution and ecology.—*Diplazium tamandarei* is endemic to Brazil, known from São Paulo and Paraná State.

SELECTED SPECIMENS EXAMINED.—BRAZIL. São Paulo: São Paulo, Serra da Cantareira, junho 1913, *Brade and Tamandaré* 6529 (B, HB, RB). Paraná: Campina Grande do Sul, Parque Estadual do Pico Paraná, Morro Camapuã, 25,25 S e 48,866 W, 8/2/2009, *Pereira et al.* 438, (UPCB, RB).

Notes.—There are two very similar species: *Diplazium hammelianum* C. D. Adams from Panama, with pubescent rachises and 3rd order pinnules, deeply incised, with entire indusia; *D. gomezianum* C. D. Adams, from Mexico to Costa Rica, has broader 3rd order pinnae. This group needs more study.

28. *Diplazium turgidum* Rosenst., Hedwigia 46: 109. 1907. – TYPE: BRAZIL. Rio Grande do Sul, Santa Cruz, Monte Alverne, *Jürgens and Stier* 148 (lectotype, here designated: S!, accession S-R-1644; isoelectotype ICN!, isotype HB!).

Figs. 2U, 3K, 9L–N.

Stem erect, $4\text{--}20 \times 1\text{--}1.8$ cm, apex scaly; *leaves* ca. 250 cm long, arched, fasciculate; *petioles* $38\text{--}150 \times 0.6\text{--}1$ cm, dark brown, with septate hairs ca. 0.1 mm, scales linear ca. 1.5×0.1 mm, and scales lanceolate ca. 15×2 mm, concolor, brown, base truncate, apices acuminate, entire; *lamina* $45\text{--}150 \times 38\text{--}77$ cm, chartaceous, 2-pinnate-pinnatifid, lanceolate, gradually tapering to a pinnatifid apex; *rachises* grooved adaxially, tomentose on groove, glabrescent abaxially, with linear to lanceolate scales like those of the petiole on the abaxial side; *pinnae* $25\text{--}62 \times 8\text{--}28$ cm, ca. 10 pairs, petiolule to 6–12 mm long; *pinnules* $7\text{--}12 \times 1.5\text{--}5$ cm, lanceolate, base truncate, equilateral, apices acuminate, crenate to serrate; *veins* free, pinnate, simple or bifurcate, 18–20 pairs, costae grooved adaxially, with wings 0.1–0.2 mm; *laminar tissue* glabrous on both surfaces; *sori* $2\text{--}5 \times 0.2\text{--}0.4$ mm, oblong, diplazioid and simple; *indusia* membranaceous, brown, toothed to short fimbriate, fimbria 0.1mm; *spores* with perispore winged, reticulate, surface and folds rugulate.

Distribution and ecology.—*Diplazium turgidum* is known only from the Brazilian Atlantic coast.

SELECTED SPECIMENS EXAMINED.—BRAZIL. Bahia: Jussari, RPPN Jussari, 12 Dec 2005, *Mynssen* 956 (RB). Minas Gerais: Camanducaia, Paraisópolis, 2 Jun 2001, *Salino* 6943 (BHCB); Rio de Janeiro: Parati, Parque Nacional da Serra da Bocaina, $23^{\circ}11'22''\text{S}$ e $44^{\circ}50'15''\text{W}$, 7 Jan 2008, *Labiak et al.* 4374 (UPCB, RB). São Paulo: Brotas, Cachoeira Caçoroba, 22 May 1993, *Rodrigues Jr and Silva*

452 (HB, BHCB). Paraná: Campina Grande do Sul, BR-116 p. Barragem Capivari, 20 Oct 1992, *Cislinski 204* (UPCB, PACA). Santa Catarina: Fazenda Sant'Anna, 25 Jun 1925, *Spannagel 441 a* (HB); Araranguá, Serra da Pedra, 7 Dec 1943, *R.Reitz 432 c* (RB). Rio Grande do Sul: Santa Cruz, Nov 1903, *Jürgens 148* (HB).

ADDITIONAL SPECIMENS EXAMINED.—ARGENTINA. Misiones: Dpto. San Pedro, Reserva de Biosfera Yabotí, Reserva Estricta Esmeralda, Estación Biológica, borde de cascada, 29 Sep 2004, *Múlgura et al. 4024* (SI).

Notes.—*Diplazium turgidum* is similar to *Diplazium hians* Klotzsch (Mexico, Central America, Venezuela, Colombia, Ecuador, and Peru) but the latter has entire or lobed indusial margins (vs. fimbriated in *D. turgidum*).

Rosenstock (1907) described *Diplazium turgidum* correlating with *D. ambiguum* by the size of the stem. In addition, *D. ambiguum* can be differentiated by having flat, full-margins, or irregularly-lobed indusia.

DOUBTFUL OR EXCLUDED APPLICATION NAMES

1. *Diplazium biserratum* (C. Presl) C.Presl, Tent. Pterid. 114, t. 4. f.2. 1836. *Asplenium biserratum* C. Presl, Del. Prag. 1. 177.1822. TYPE: “*Hab. In Brazilia*” (type PR?).

According to Presl (1822) this species can be distinguished by the ovate-lanceolate leaves, alternate, sub-sessile and inequilateral pinnatifid pinnae, with an acute and serrated margin, and with sori near the costae and scaly petioles. Although Fée (1869) had considered this species to be Brazilian, he comments that it is very little known. No type collection was found, and therefore it is a name doubtful application.

2. *Diplazium coarctatum* Link, Hort. Berol. 2: 71. 1833. TYPE: “*Hab. In Brazilia C.*” (type B?).

The description refers to a plant with bipinnatifid leaves and acuminate pinnae, with lanceolate, obtuse pinnules and distinguished from *Diplazium dubium* Link (= *D. cristatum*) by broader leaves, rachises with small scales and with pinnae, pinnules, and lacinia longer than their congeners. The type collection was not found and for this reason, we consider the name to be of doubtful application.

3. *Diplazium subalatum* Houlst. and T. Moore, Gard. Mag. Bot. 3. 231. 1851. (type ?)

Allan Cunningham was a collector of Kew Gardens and originally left his material to Robert Heward, who donated duplicates for cultivation. Later, part of this collection was donated to the Oxford-OXF herbarium (Stafleu and Cowan, 1976). The description of *Diplazium subalatum* is possibly based on cultivated material, because it was published in the journal “The Gardeners Magazine of Botany”. Although there is no clear indication of the type material, the authors

cite R. Heward MS. (manuscript) and point the occurrence to Brazil, Venezuela, and other areas of tropical America. Based on the original literature it is not possible to know to which taxon the name is applied.

4. *Diplazium alternifolium* Blume, Enum. Pl. Jave, 8^a. ed. 190. 1828. TYPE: Java (type L, photo B!).

In the Paris herbarium we found a specimen collected by Martin Reineck at the Public Walk of Porto Alegre city in the Rio Grande do Sul state. It was probably cultivated, as the type is from Java and this is the only material that indicates a distribution in Brazil.

5. *Diplazium costale* (Sw.) C. Presl, Tent. Pterid. 114. 1836. *Asplenium costale* Sw., J. Bot. 1800 (2): 55. 1802. TYPE: Jamaica, Swartz s.n. (type: S photo!).

Fée (1869) applied the name *Diplazium costale* to two specimens collected in Brazil. However, a careful examination of these specimens shows that *Blanchet 535* (NY) refers to *D. celtidifolium* Kunze, whereas *D. rostratum* Fée would be the correct name for *Miers 164* (K).

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APPENDIX 1: LIST OF COLLECTORS NAMES AND NUMBERS

- A.STIVAL-SANTOS & S.SILVEIRA 426 (7)
- Abe, L.M. 399 (7)
- Achethe 138 (3)
- Achette, P. 98 (7)
- Almeida Neto 43, 172 (7)
- Almeida, T.A. et al. 1522 (13)
- Almeida, T.E. 1980 (26), 2875 (13)
- Almeida, T.E. et al. 1538 (5)
- Alunos s.n. (7)
- Amaral, I.L. et al. 1302 (7)
- Amorim et al. 4206 (18)
- Amorim, A. 621 (4), 2902 (20)
- Amorim, A.M. 8141 (6)
- Ana Paula s.n. (15)
- Ana Paula & Maria Emilia s.n. (15)

- Andrade-Lima 72-7019 (7)
Annies, L. 248 (10)
Anries 76 (3)
Araujo, D. 2004 (3)
Assis, E. L. M. 253, 429 (7)
Athayde, F. 221 (3), 372 (7), 381 (3)
Azevedo, A.A. s.n. (7)
Azevedo, A.A. s.n. (20)
Baber, Kristin KB108(7), KB109(7), KB110(7), KB337(3), KB343 (3), KB413(7), KB417 (7), KB556 (20)
Backes, A. 116 (7)
Badini 36 (20), 188 (23)
Badini, J. 29 (3), 87 (3), 46 (13), 72 (7), s.n. (13)
Baeta s.n. (18)
Baez, C. 916 (20)
Balansa, B. 2889 (28)
Barbosa, E. 45 (20), 717 (7)
Barbosa, E. & Silva, J.M. 253 (7), 434 (20)
Barbosa, F. 973 (7)
Barcia 1387 (15)
Barreto, M. 5045 (7)
Bello, W 525 (3)
Blanchet 841 (20), 2231 (7), 2262 (20), 2459 (20), 2474 (18), 2476 (18), 2509 (18), 3939 (6), 247b (7), s.n. (4)
Bory 1802 (28)
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DEAN WHITTIER (1936–2019)



JAMES D. CAPONETTI

Division of Biology Teaching and Learning,
University of Tennessee, Knoxville,

With thanks to Dean's wife, Virginia Whittier, of Nashville, Tennessee, who provided some details.

DEAN WHITTIER was born in Worcester, Massachusetts, and grew up in the nearby town of Millbury. He earned a B.S. degree in Botany from the University of Massachusetts, Amherst. Dean and I were fellow graduate students at Harvard University, and we earned non-thesis A.M. degrees in Biology in 1959 and Ph.D. degrees in Biology in 1961. Dean's first academic position was at Virginia Polytechnic Institute from 1961 to 1964. At that time, VPI was a private military institution: the name was later changed to Virginia Polytechnic Institute and State University when it became a state-supported public university. Dean left "Virginia Tech" in 1964 to accept a Post-Doctoral Fellowship at Harvard University for one year. He then accepted an academic position at Vanderbilt University in 1965 where he remained until he retired as Professor Emeritus of Biological Sciences in 2001. Dean stayed on at Vanderbilt University conducting research until about mid-2018.

Dean's research focused on spore germination and studies of the gametophytes of ferns and lycophytes. His doctoral dissertation involved the induction of apogamy in bracken fern *Pteridium aquilinum* var. *latiusculum* in sterile culture. After graduation he conducted further studies on apogamy in *Cyrtomium falcatum*. Dean's fascination over the fact that the gametophytes of some species of ferns and fern allies are not found in abundance under natural conditions led him to conduct spore germination experiments in sterile culture for several species of *Ophioglossum*, *Huperzia*, and *Lycopodium* as well as *Psilotum nudum* under conditions of darkness, white light, red light, and far-red light plus on culture media at various levels of pH. Some of Dean's latest investigations included the nutritional aspects of those gametophytes that contain endophytic fungi.

Dean was a member of several botanical societies including the *Botanical Society of America* and the *American Fern Society*. For the latter society, he served as Treasurer from 1974 to 1976 and was elected to Honorary Membership in 2007. When his term as Treasurer was ending, he nominated me to succeed him, and I was elected to office in 1976. Dean and I attended and socialized at annual botany meetings while presenting the results of our research at organized, oral presentation sessions. Dean was a humble and quiet man but a cordial conversationalist with friends and colleagues he knew well.

Dean was a sports fan and especially liked hockey. He followed the games of many teams in the Boston, Massachusetts area and in Tennessee. We often exchanged friendly comments over the wins and losses of our favorite teams.

Dean died May 29, 2019 at the age of 83. He is survived by his wife of nearly 61 years, Virginia E. (Johnson) Whittier; a son Ethan Whittier of San Jose,

California; a daughter Karen Whittier of Nashville, Tennessee; a brother Craig Whittier and his wife Barbara of Millbury, Massachusetts; a niece; and two nephews. Private funeral services and burial were held in Sutton, Massachusetts. Rest in peace, my friend.

SELECTED PUBLICATIONS OF DEAN'S RESEARCH

WHITTIER, D.P. and T.A. STEEVES. 1960. The induction of apogamy in the bracken fern. *Canadian Journal of Botany* 38:925-930.

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WHITTIER, D.P. 2015. Delayed growth in mycoheterotrophic gametophytes of seedless vascular plants. *American Fern Journal* 105:1-10.

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COVER CAPTION: Fiddlehead of *Diplazium lindbergii* collected in the municipality of São José do Barreiro, São Paulo State (Mynssen 1029, RB). Photo credit: Claudine Mynssen